

TEST REPORT

of

FCC Part 15 Subpart C §15.209
FCC ID : TQ8-IBU-4E01

Equipment Under Test : SMART KEY ECU
Model Name : IBU-4E01
Applicant : Hyundai Mobis Co.,Ltd.
Manufacturer : AUTONICS Co., Ltd.
Date of Receipt : 2016.11.30
Date of Test(s) : 2016.12.12 ~ 2016.12.22
Date of Issue : 2016.12.23

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



Date:

2016.12.23

Brant Jang

Technical Manager:



Date:

2016.12.23

Hyunchae You

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RTT5041-20(2015.10.01)(3)

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A4(210 mm x 297 mm)

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

Phone No. : +82 31 688 0901

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1.2. Details of Applicant

Applicant : Hyundai Mobis Co., Ltd.

Address : 203, Teheran-ro, Gangnam-gu, Seoul, 06141, Republic of Korea

Contact Person : Choi, Seung-Hoon

Phone No. : +82 31 260 0098

1.3. Description of EUT

Kind of Product		SMART KEY ECU
Model Name		IBU-4E01
Power Supply		DC 12.0 V
Frequency Range		Tx: 125.00 kHz (LF Antenna) Rx: 433.92 MHz (RF Antenna)
Modulation Technique		ASK
Number of Channels		1
Operating Conditions		-30 °C ~ 75 °C
Antenna Type	Tx	External Type (Coil Antenna)
	Rx	Internal Type

1.4. Declarations by the manufacturer

- RF antenna is only Receiver antenna
- The EUT of antennas cannot operate at the same time.

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1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due.
Spectrum Analyzer	R&S	FSV30	100768	Mar. 30, 2016	Annual	Mar. 30, 2017
Test Receiver	R&S	ESU26	100109	Mar. 07, 2016	Annual	Mar. 07, 2017
Signal Generator	R&S	SMBV100A	255834	Jun. 20, 2016	Annual	Jun. 20, 2017
DC Power Supply	Agilent	U8002A	MY50060028	Mar. 21, 2016	Annual	Mar. 21, 2017
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug.19, 2015	Biennial	Aug.19, 2017
Turn Table	INN-CO GmbH	CONTROLLER CO3000	N/A	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.

1.6. Sample calculation

Where relevant, the following sample calculation is provided:

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB) + Cable loss (dB)

1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart C §15.209		
Section in FCC 15 Subpart C	Test Item	Result
15.209	Radiated emission, Spurious Emission and Field Strength of Fundamental	Complied
2.1049	20 dB Bandwidth	Complied

1.8. Test Report Revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL010669	2015.12.23	Initial

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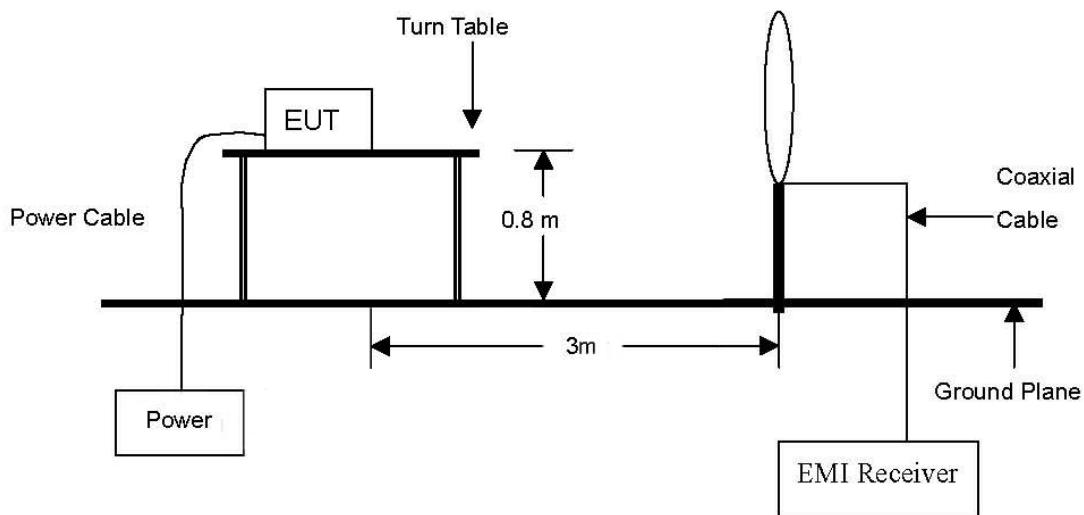
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2. Field Strength of Fundamental

2.1. Test Setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



2.2. Limit

2.2.1. Radiated emission limits, general requirements

According to §15.209 (a), Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meter)
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections §15.231 and §15.241

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2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

2.3.1. Test Procedures for emission from 9 kHz to 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
- c. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- d. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 meter open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.

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2.4. Field Strength of Fundamental Test Result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical. The field strength of spurious emission was measured in one orthogonal EUT position (x-axis). Definition of EUT for a orthogonal plane was described in the test setup photo.

-DRV Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m) at 300 m	Margin (dB)
0.125	63.70	Average	H	19.44	0.06	83.20	3.20	25.67	22.47

-AST Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m) at 300 m	Margin (dB)
0.125	62.80	Average	H	19.44	0.06	82.30	2.30	25.67	23.37

-INT1 Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m) at 300 m	Margin (dB)
0.125	60.50	Average	H	19.44	0.06	80.00	0.00	25.67	25.67

-INT2 Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m) at 300 m	Margin (dB)
0.125	59.30	Average	H	19.44	0.06	78.80	-1.20	25.67	26.87

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-BUM Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m) at 300 m	Margin (dB)
0.125	61.00	Average	H	19.44	0.06	80.50	0.50	25.67	25.17

-TRU Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m) at 300 m	Margin (dB)
0.125	60.50	Average	H	19.44	0.06	80.00	0.00	25.67	25.67

-SSB Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m) at 300 m	Margin (dB)
0.125	68.80	Average	H	19.44	0.06	88.30	8.30	25.67	17.37

Note:

1. According to §15.31 (f)(2) 300 m Result (dB μ V/m) = 3 m Result (dB μ V/m) - 40log(300/3) (dB μ V/m).
2. According to §15.209 (d), the measurements were tested by using Quasi peak detector except for the frequency bands 9 – 90 kHz, 110 – 490 kHz and above 1 GHz in these three bands on measurements employing an average detector.
3. The limit above was calculated based on table of §15.209 (a).

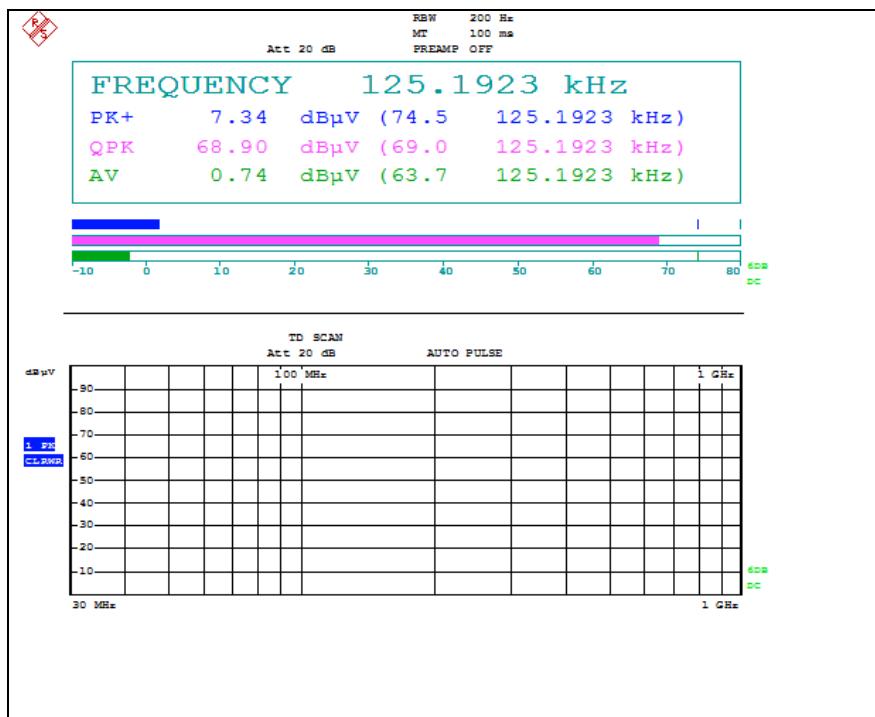
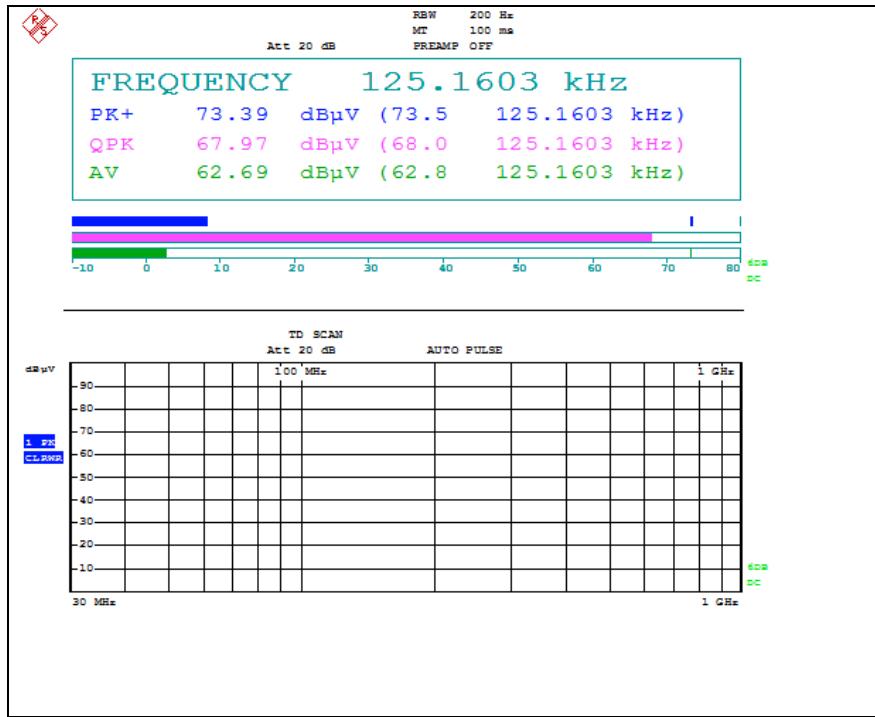
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DRV Antenna**AST Antenna**

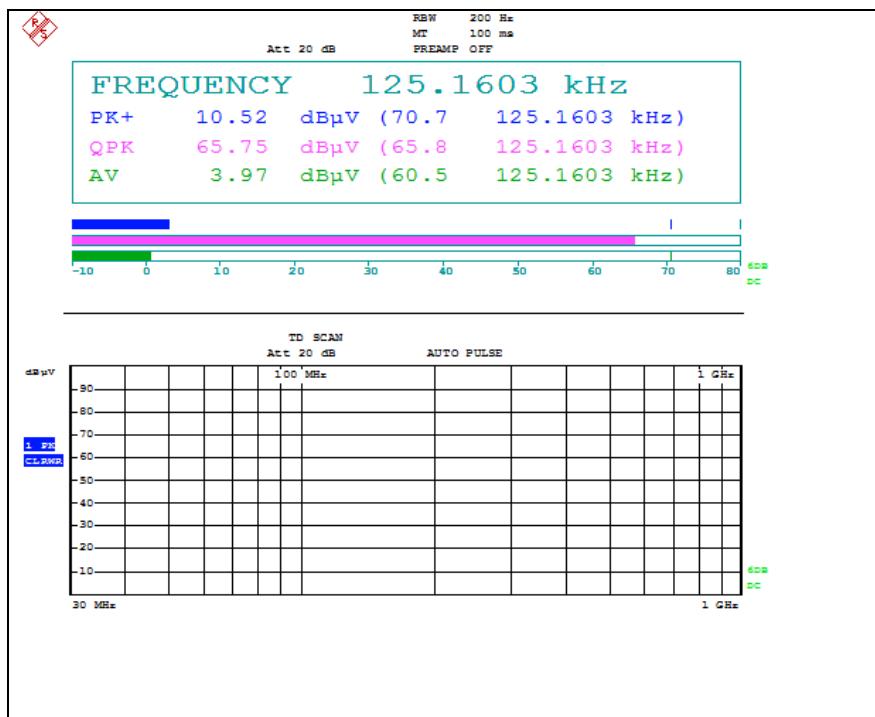
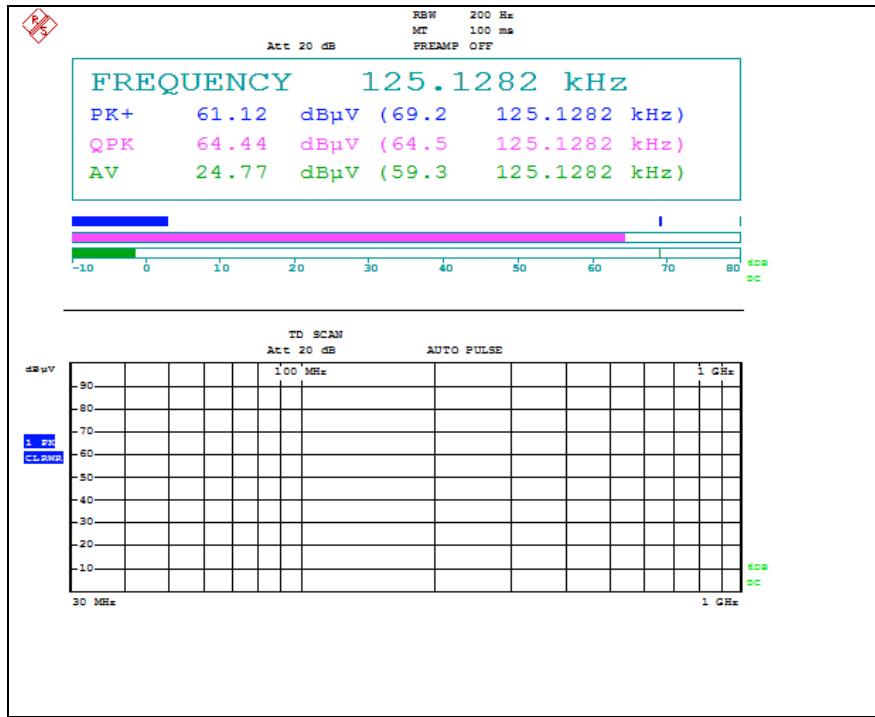
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INT1 Antenna**INT2 Antenna**

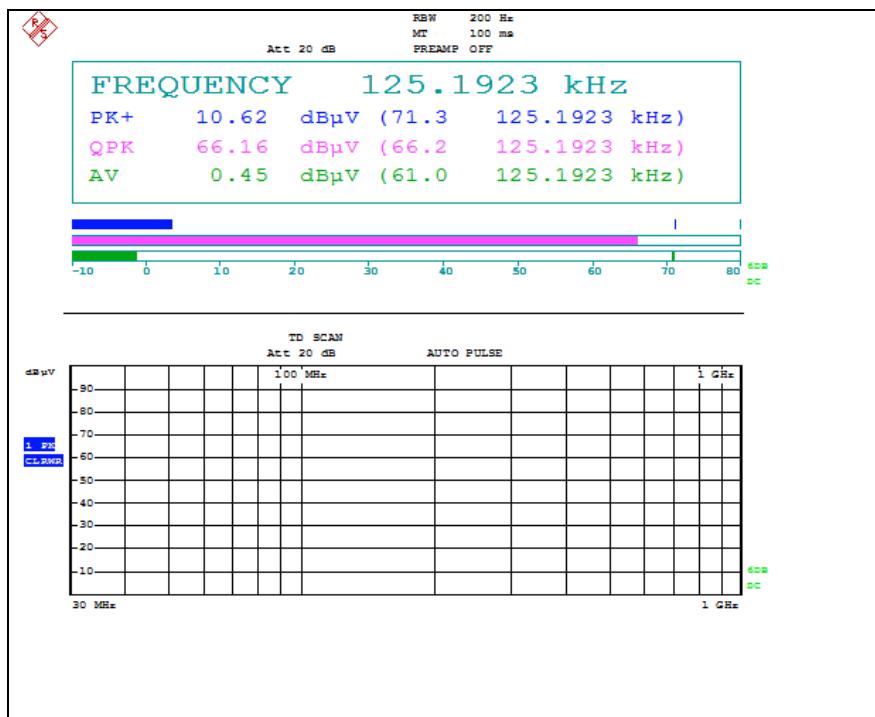
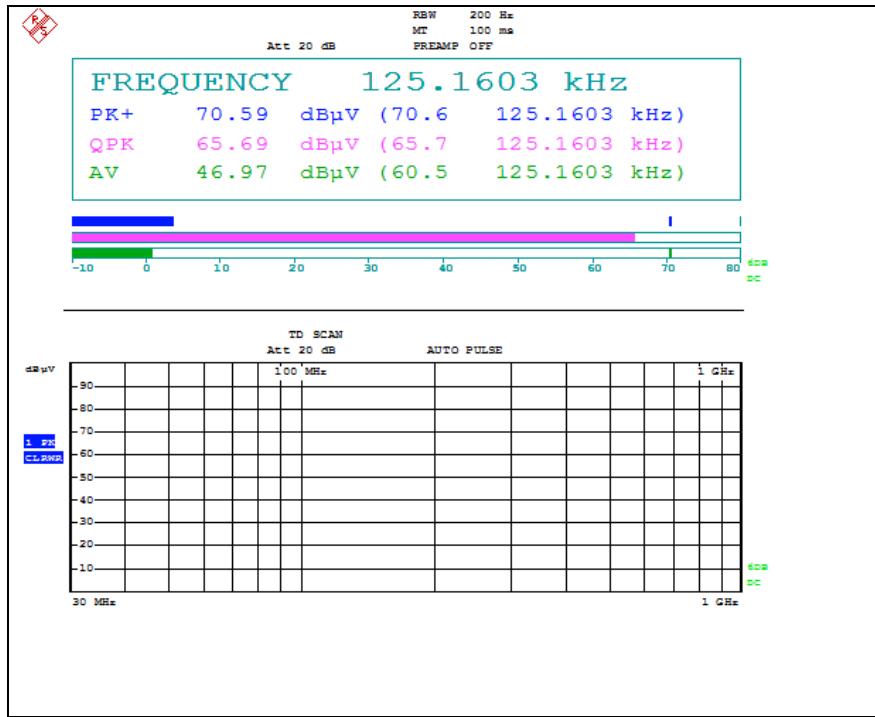
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A4(210 mm x 297 mm)

BUM Antenna**TRU Antenna**

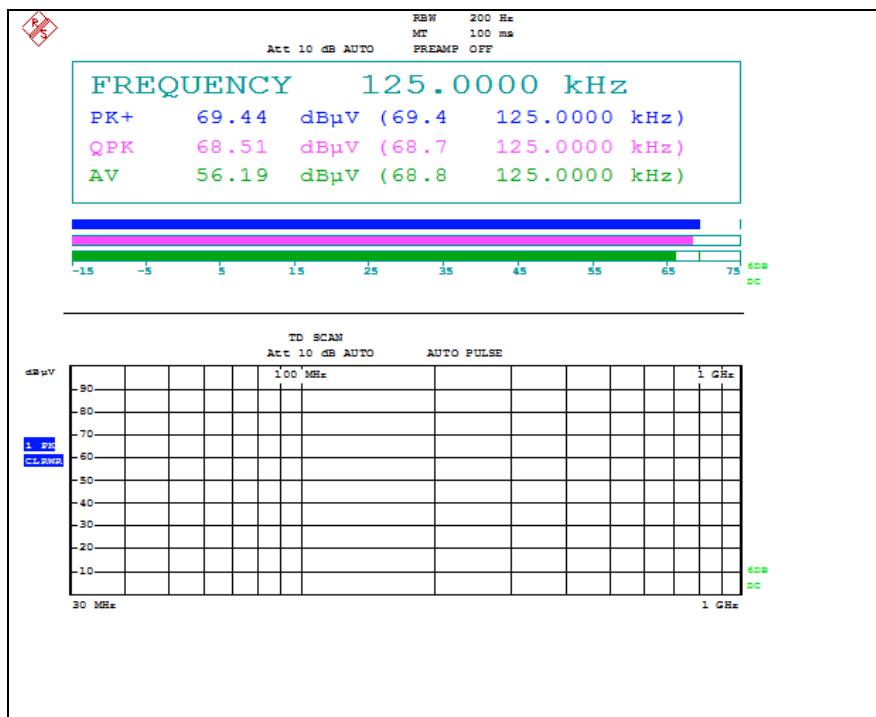
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2.5. Spurious Emission Test Result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

-DRV Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30m or 300 m	Limit (dB μ V/m) at 30m or 300 m	Margin (dB)
0.035	25.60	Average	H	19.30	0.03	44.93	-35.07	36.72	71.79
0.090	16.90	Average	H	19.46	0.04	36.40	-43.60	28.53	72.13
0.113	35.20	Average	H	19.47	0.05	54.72	-25.28	26.54	51.82
0.129	35.40	Average	H	19.43	0.07	54.90	-25.10	25.39	50.49
2.456	9.70	Quasi Peak	H	19.33	0.54	29.57	-10.43	29.54	39.97
9.293	2.50	Quasi Peak	H	19.86	0.34	22.70	-17.30	29.54	46.84
Above 10.000	Not Detected	-	-	-	-	-	-	-	-

-AST Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30m or 300 m	Limit (dB μ V/m) at 30m or 300 m	Margin (dB)
0.022	30.80	Average	H	19.46	0.02	50.28	-29.72	40.76	70.48
0.106	32.80	Quasi Peak	H	19.49	0.05	52.34	-27.66	27.10	54.76
0.113	34.70	Average	H	19.47	0.05	54.22	-25.78	26.54	52.32
0.145	23.90	Average	H	19.39	0.08	43.37	-36.63	24.38	61.01
0.533	11.80	Quasi Peak	H	19.12	0.42	31.34	-8.66	33.07	41.73
Above 1.000	Not Detected	-	-	-	-	-	-	-	-

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-INT1 Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30m or 300 m	Limit (dB μ V/m) at 30m or 300 m	Margin (dB)
0.022	27.80	Average	H	19.46	0.02	47.28	-32.72	40.76	73.48
0.045	17.40	Average	H	19.30	0.03	36.73	-43.27	34.54	77.81
0.113	35.10	Average	H	19.47	0.05	54.62	-25.38	26.54	51.92
0.131	17.30	Average	H	19.42	0.07	36.79	-43.21	25.26	68.47
1.218	7.70	Qusi Peak	H	19.39	0.78	27.87	-12.13	25.89	38.02
Above 2.000	Not Detected	-	-	-	-	-	-	-	-

-INT2 Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30m or 300 m	Limit (dB μ V/m) at 30m or 300 m	Margin (dB)
0.022	30.50	Average	H	19.46	0.02	49.98	-30.02	40.76	70.78
0.106	32.10	Qusi Peak	H	19.49	0.05	51.64	-28.36	27.10	55.46
0.113	36.10	Average	H	19.47	0.05	55.62	-24.38	26.54	50.92
0.145	22.90	Average	H	19.39	0.08	42.37	-37.63	24.38	62.01
1.202	7.80	Qusi Peak	H	19.39	0.78	27.97	-12.03	26.01	38.04
Above 2.000	Not Detected	-	-	-	-	-	-	-	-

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-BUM Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30m or 300 m	Limit (dB μ V/m) at 30m or 300 m	Margin (dB)
0.022	29.80	Average	H	19.46	0.02	49.28	-30.72	40.76	71.48
0.046	20.80	Average	H	19.30	0.03	40.13	-39.87	34.35	74.22
0.069	23.80	Average	H	19.38	0.03	43.21	-36.79	30.83	67.62
0.130	22.80	Average	H	19.43	0.07	42.30	-37.70	25.33	63.03
0.594	9.70	Qusi Peak	H	19.16	0.47	29.33	-10.67	32.13	42.80
Above 1.000	Not Detected	-	-	-	-	-	-	-	-

-TRU Antenna

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30m or 300 m	Limit (dB μ V/m) at 30m or 300 m	Margin (dB)
0.023	30.00	Average	H	19.44	0.02	49.46	-30.54	40.37	70.91
0.046	21.20	Average	H	19.30	0.03	40.53	-39.47	34.35	73.82
0.113	35.90	Average	H	19.47	0.05	55.42	-24.58	26.54	51.12
0.133	24.50	Average	H	19.42	0.07	43.99	-36.01	25.13	61.14
0.640	9.90	Qusi Peak	H	19.18	0.51	29.59	-10.41	31.48	41.89
Above 1.000	Not Detected	-	-	-	-	-	-	-	-

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Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30m or 300 m	Limit (dB μ V/m) at 30m or 300 m	Margin (dB)
0.117	37.20	Average	H	19.45	0.06	61.31	-18.69	26.02	44.71
0.120	41.80	Average	H	19.46	0.05	56.71	-23.29	26.24	49.53
0.130	37.20	Average	H	19.43	0.07	56.70	-23.30	25.33	48.63
0.138	23.60	Average	H	19.41	0.07	43.08	-36.92	24.81	61.73
0.375	31.00	Average	H	19.04	0.28	50.32	-29.68	16.12	45.80
0.626	22.82	Quasi Peak	H	19.18	0.50	42.50	2.50	31.67	29.17
2.877	14.60	Quasi Peak	H	19.31	0.46	34.37	-5.63	29.54	35.17
Above 3.000	Not Detected	-	-	-	-	-	-	-	-

Note:

- According to §15.31 (f)(2)
 - 300 m Result(dB μ V/m) = 3 m Result(dB μ V/m) - 40log(300/3) (dB μ V/m)
 - 30 m Result(dB μ V/m) = 3 m Result(dB μ V/m) - 40log(30/3) (dB μ V/m)
- According to field strength table of general requirement in §15.209 (a), field strength limits below 1.705 MHz were calculated as below.
 - 9 kHz to 490 kHz : 20log(2 400 / F (kHz)) at 300 m (dB μ V/m)
 - 490 kHz to 1 705 kHz : 20log(24 000 / F (kHz)) at 30 m (dB μ V/m)
- According to §15.209 (d), the measurements were tested by using Quasi peak detector except for the frequency bands 9 – 90 kHz, 110 – 490 kHz and above 1 GHz in these three bands on measurements employing an average detector.

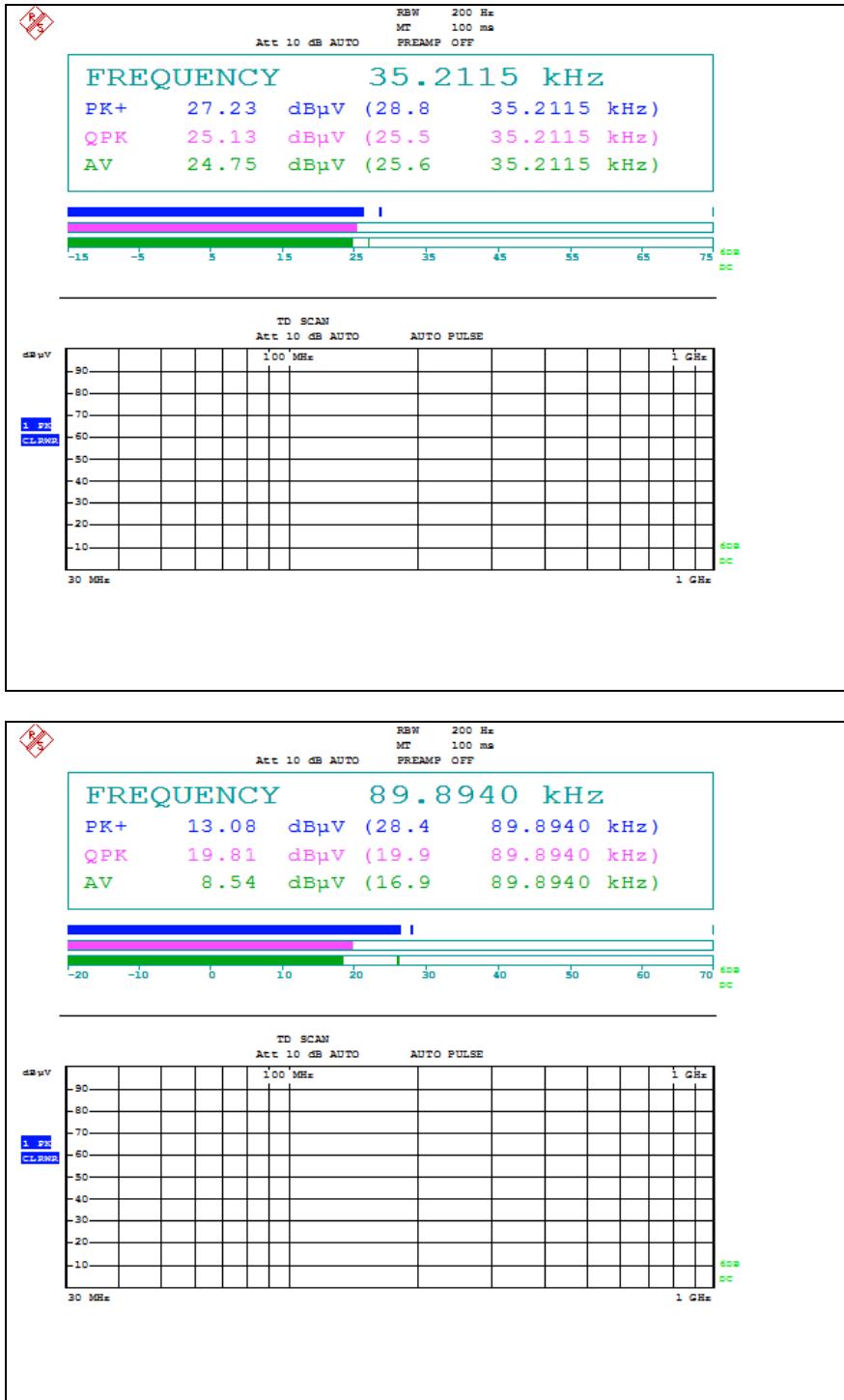
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RTT5041-20(2015.10.01)(3)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

DRV Antenna

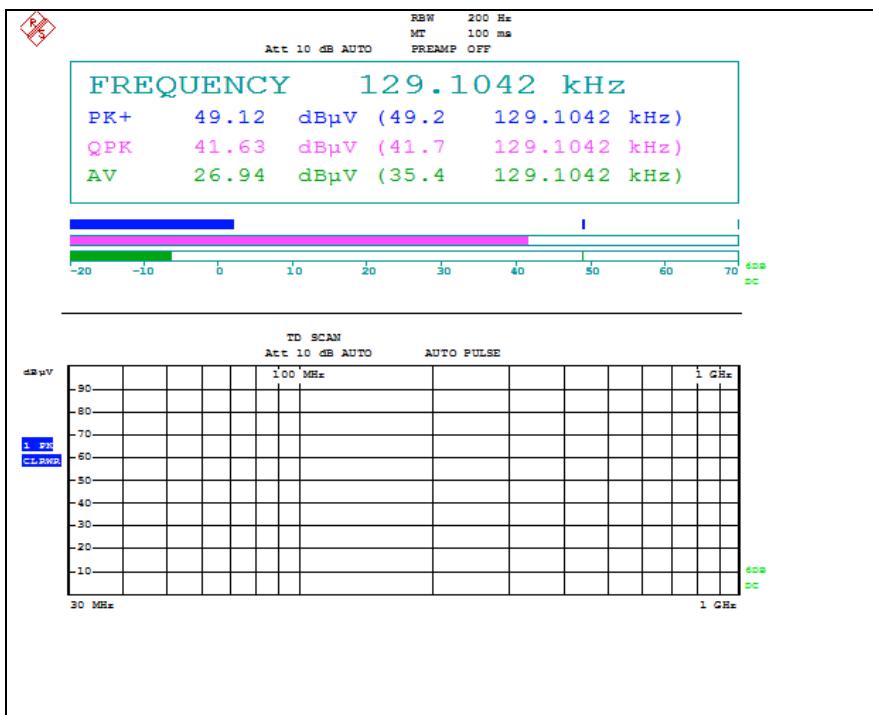
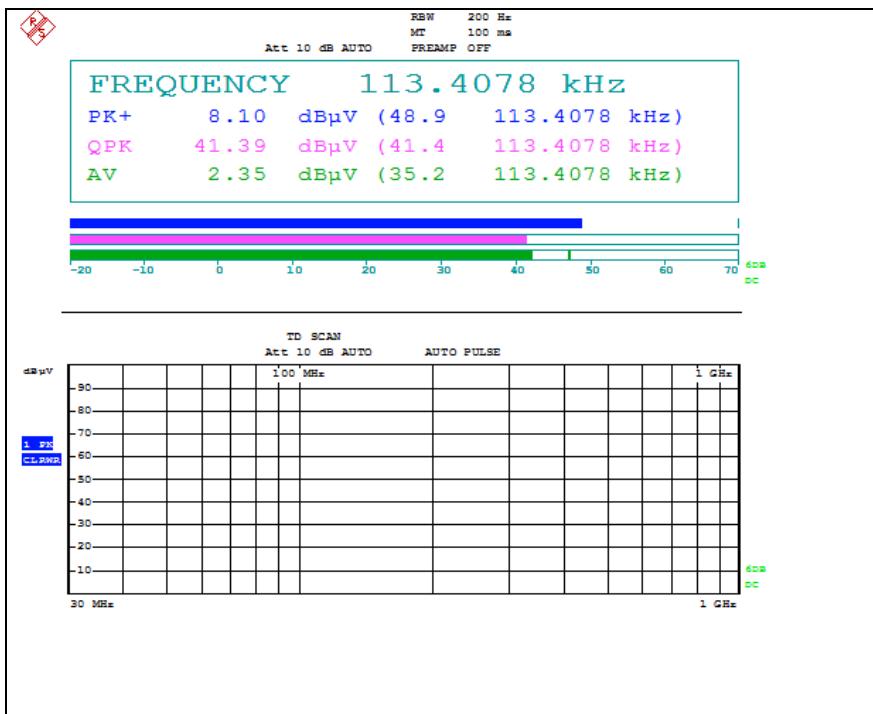
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A4(210 mm x 297 mm)



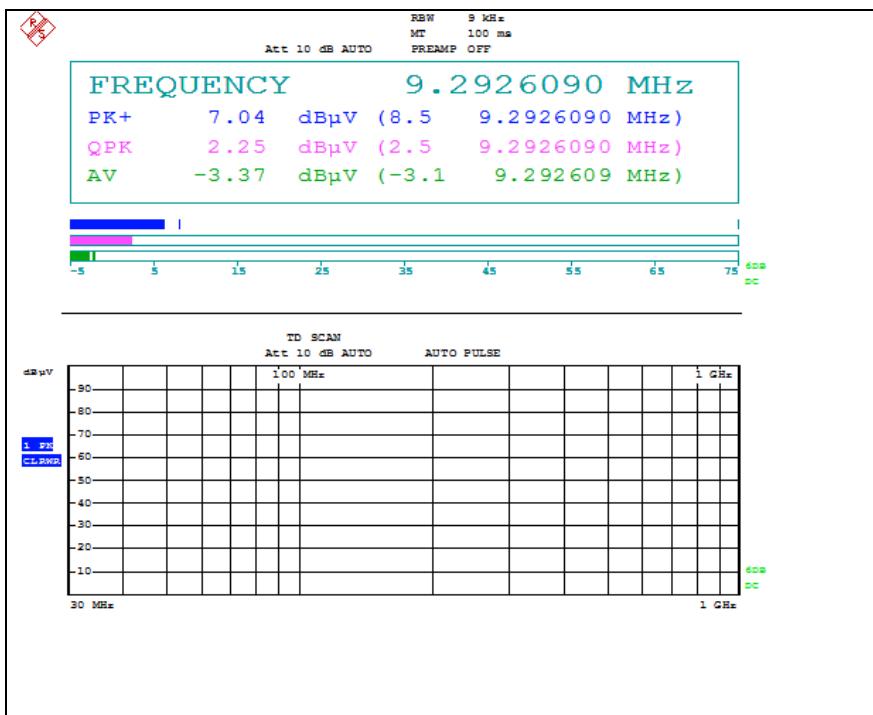
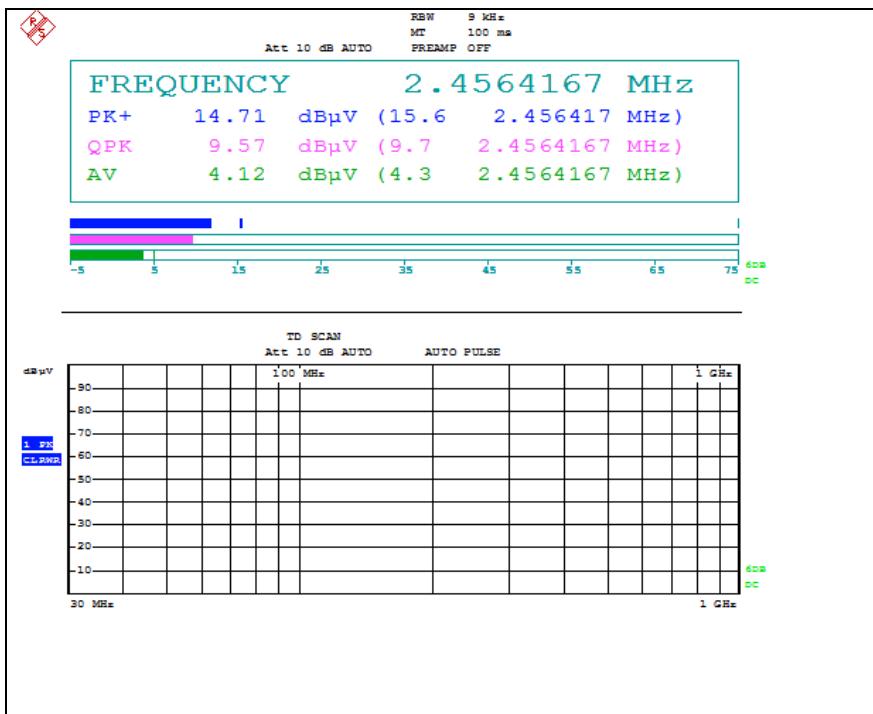
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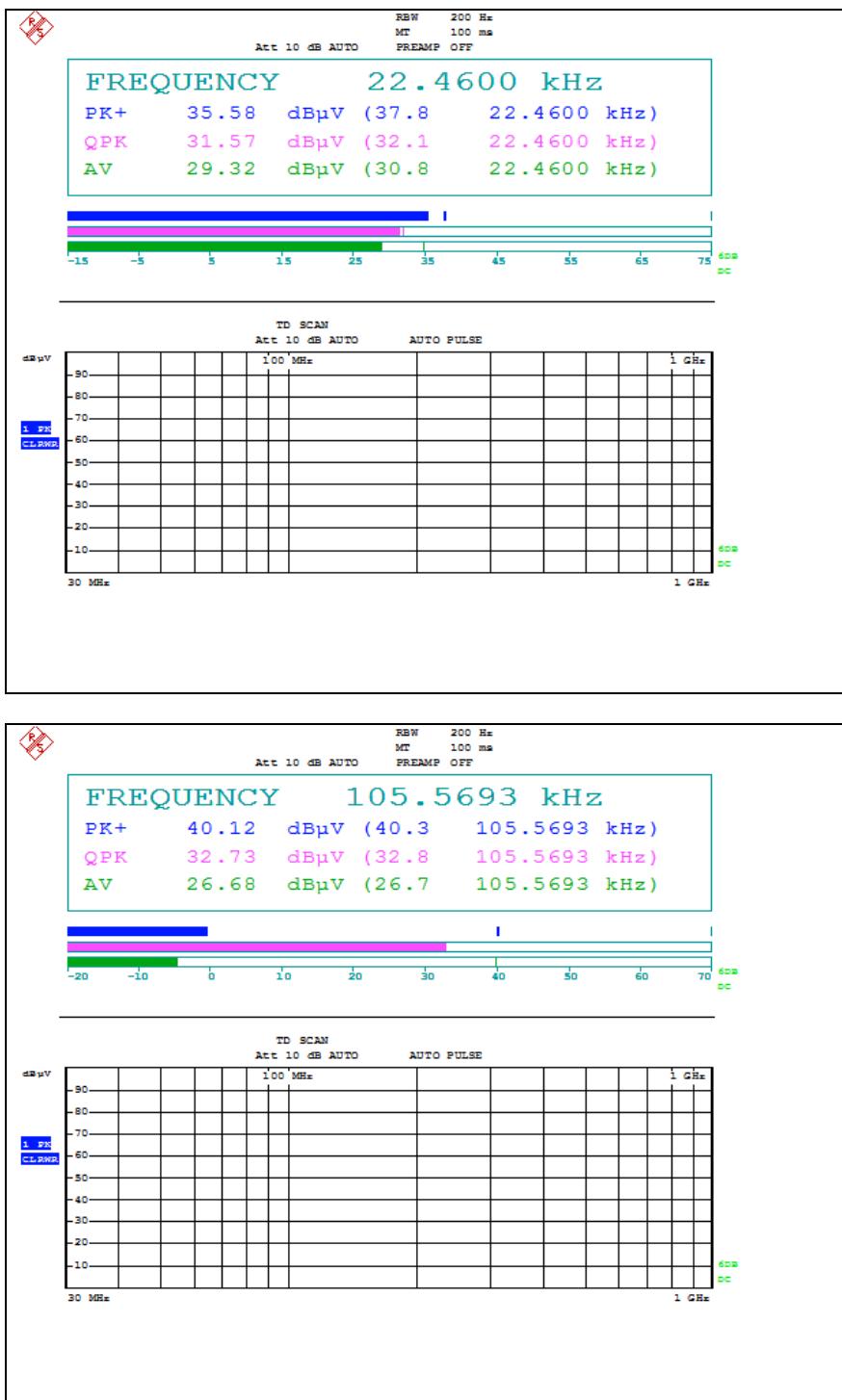
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)



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AST Antenna

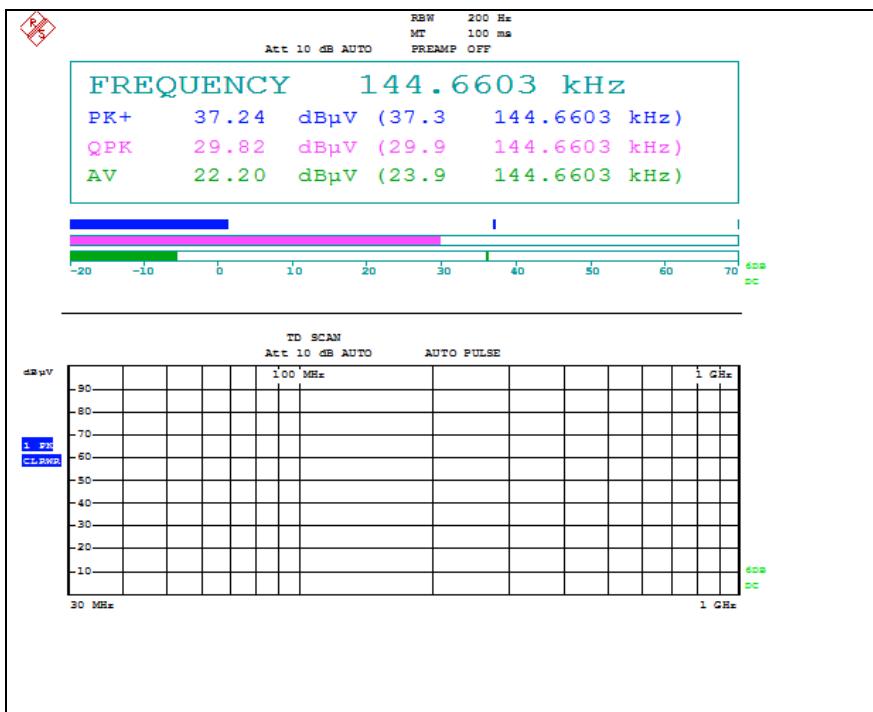
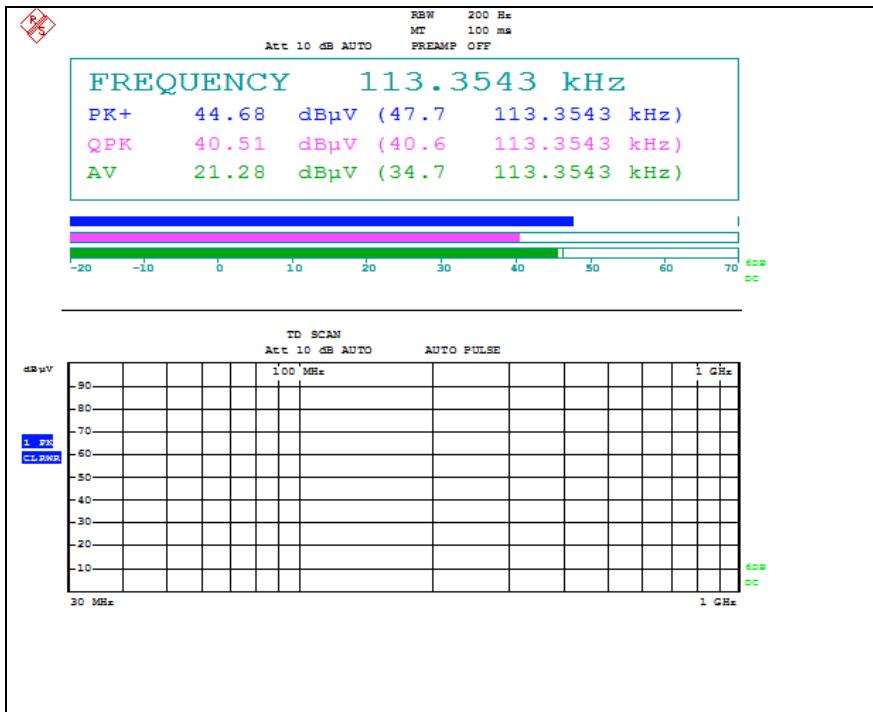
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Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)



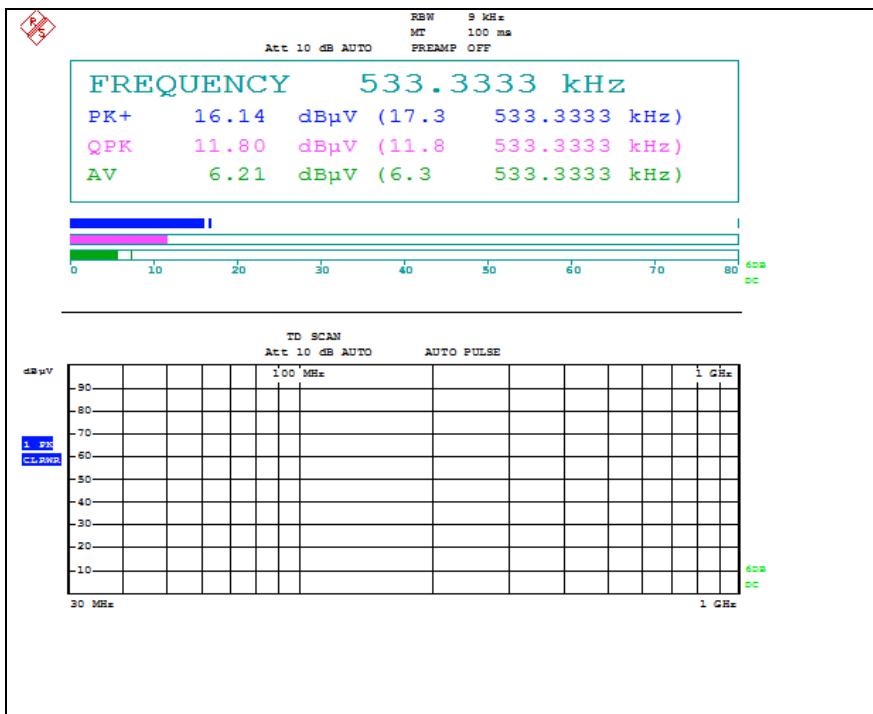
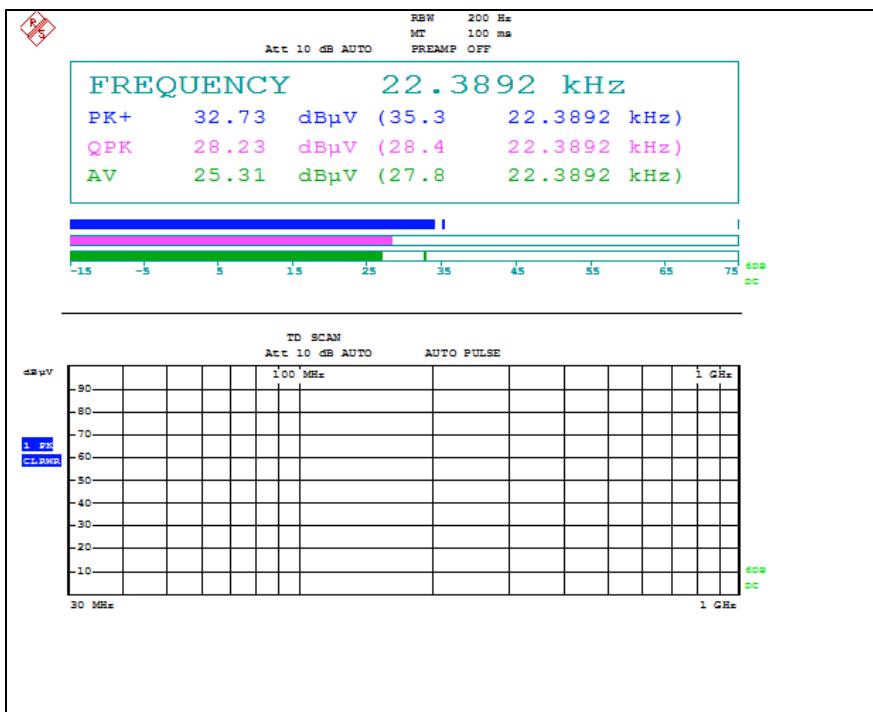
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A4(210 mm x 297 mm)

**INT1 Antenna**

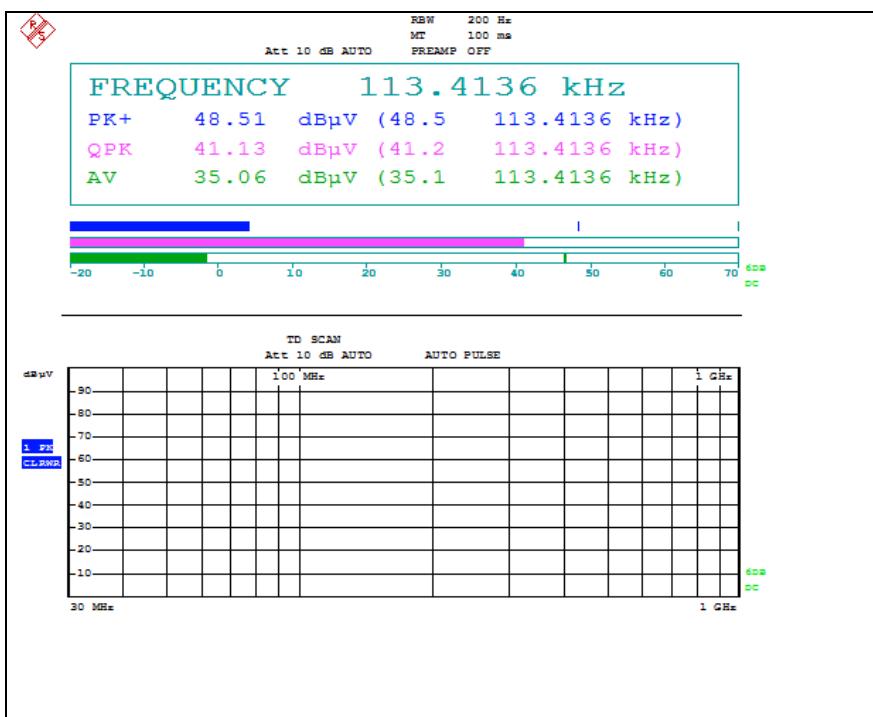
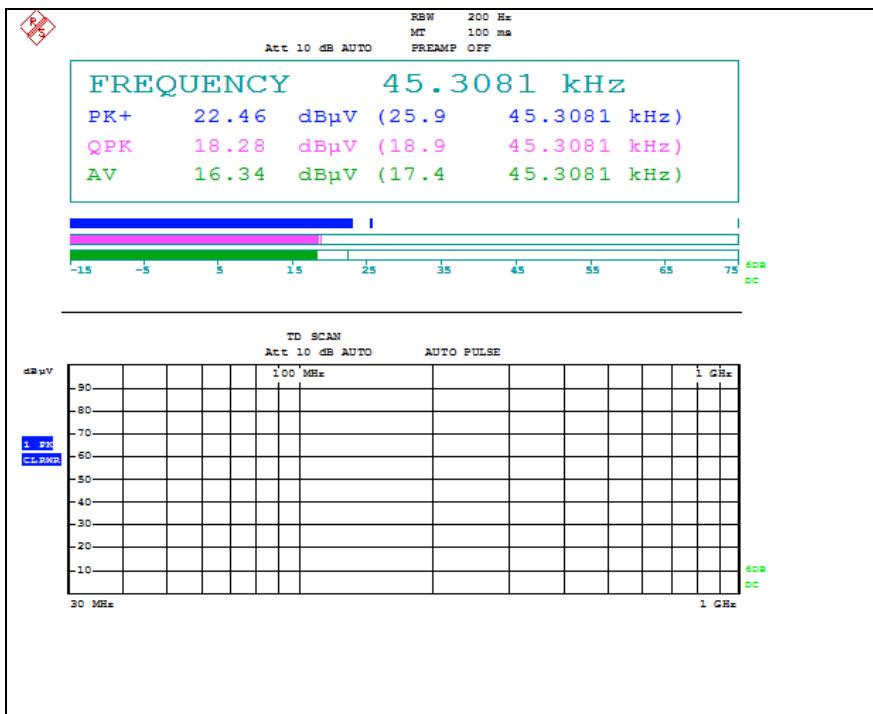
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RTT5041-20(2015.10.01)(3)

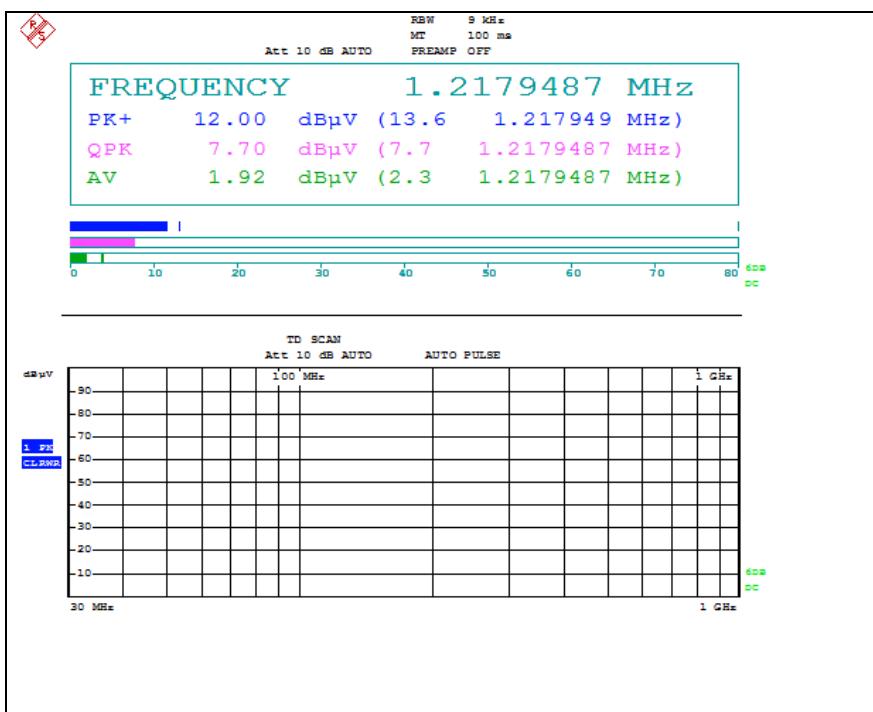
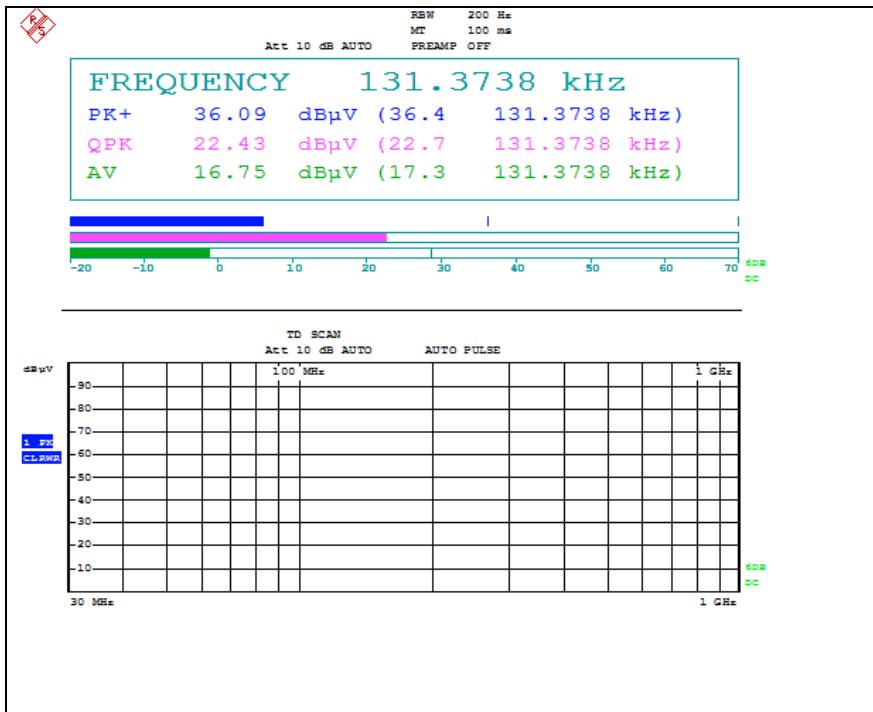
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)



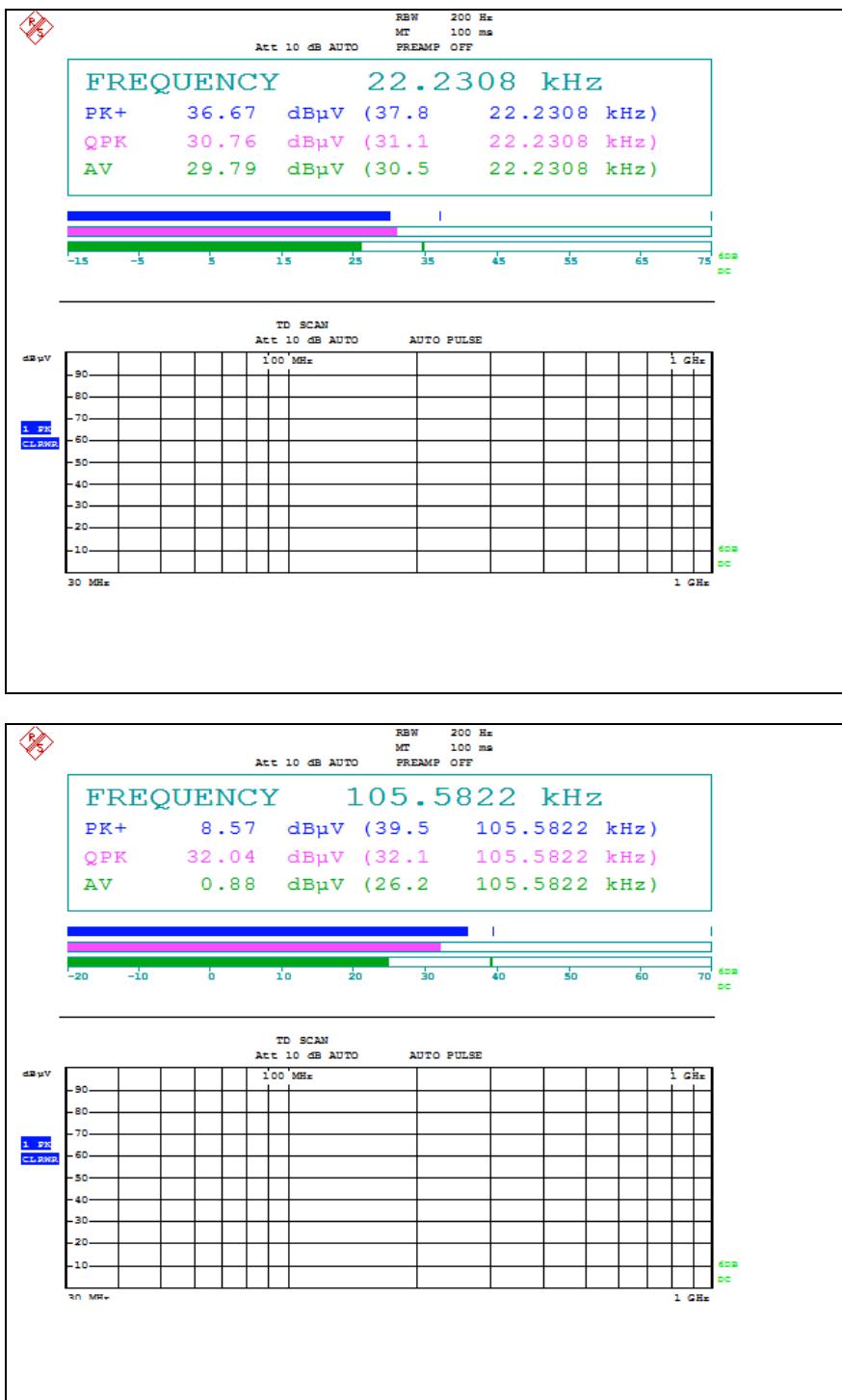
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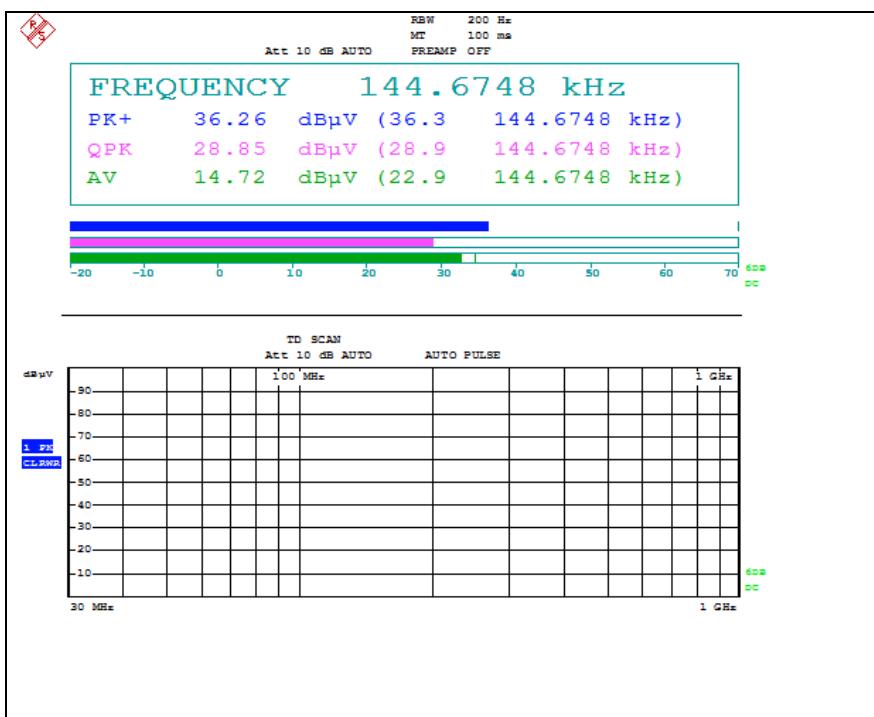
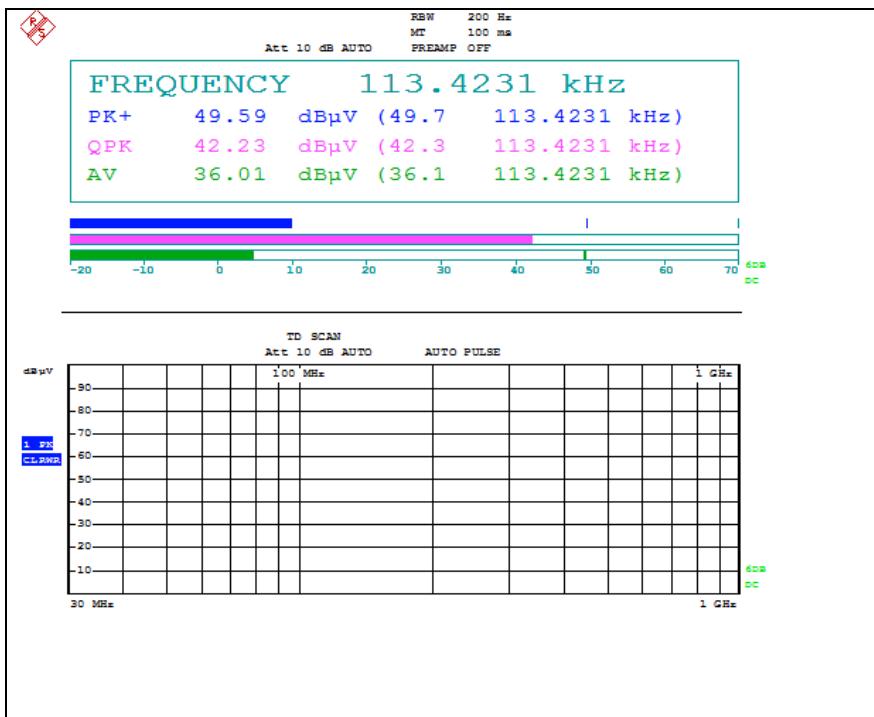
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INT2 Antenna

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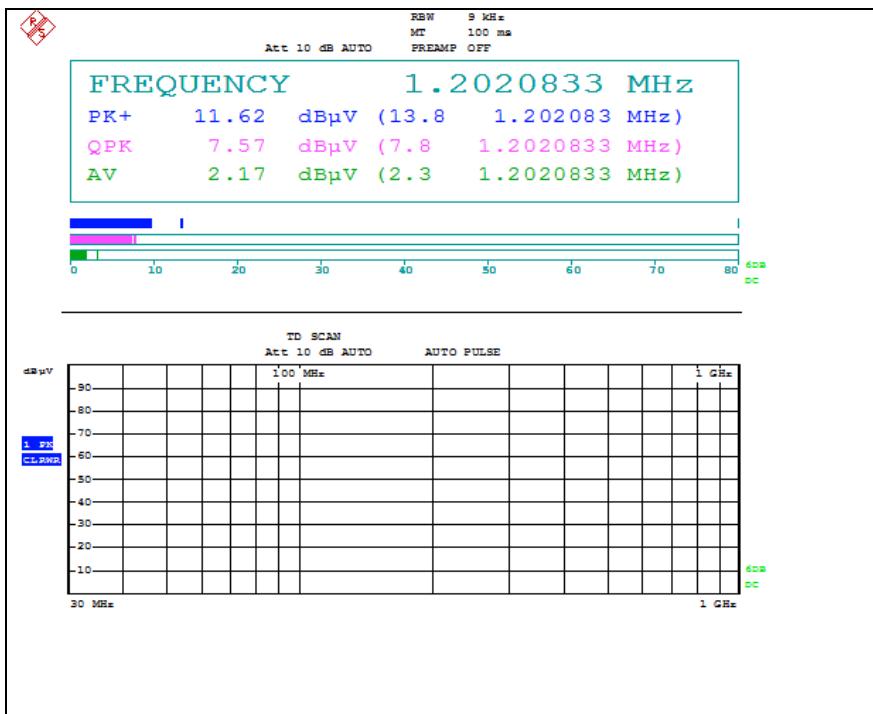
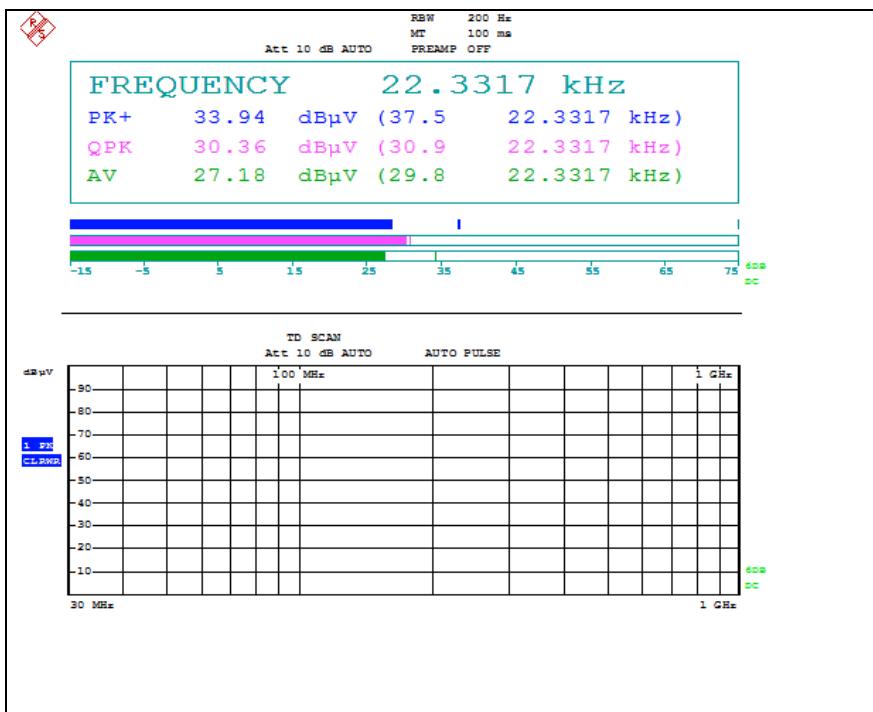
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Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm × 297 mm)

**BUM Antenna**

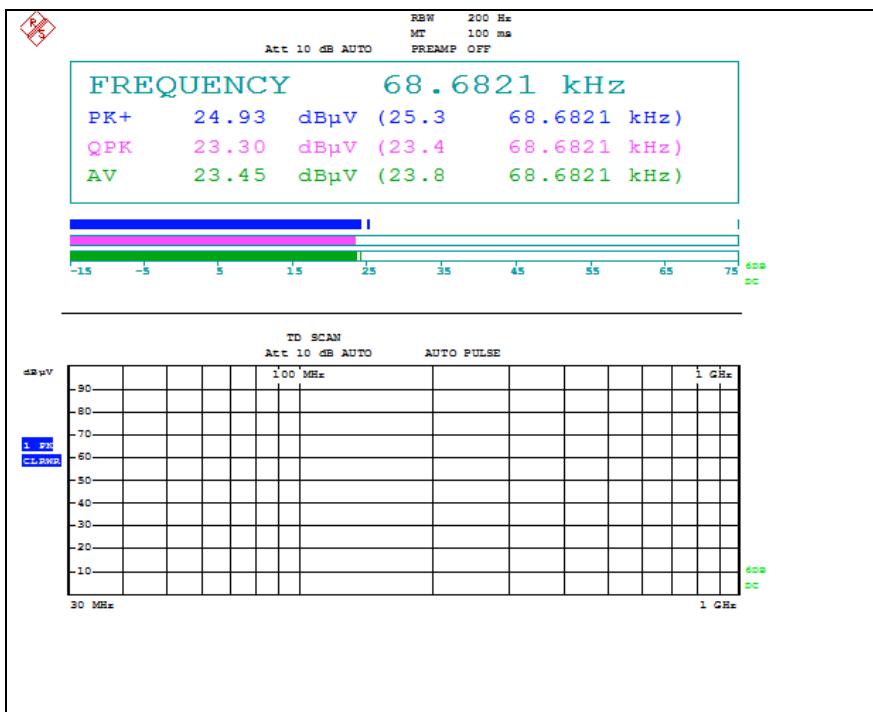
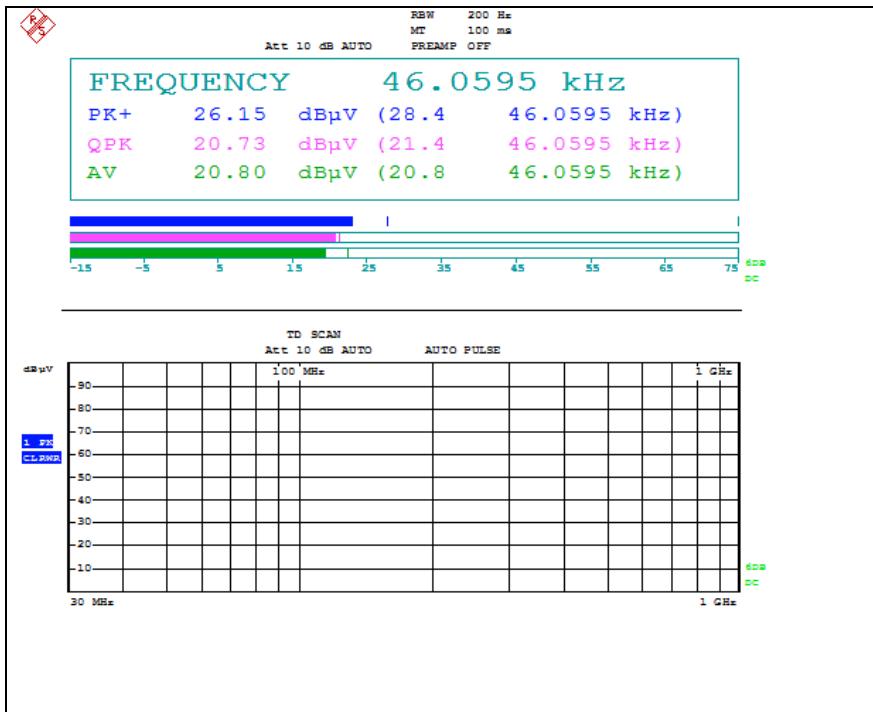
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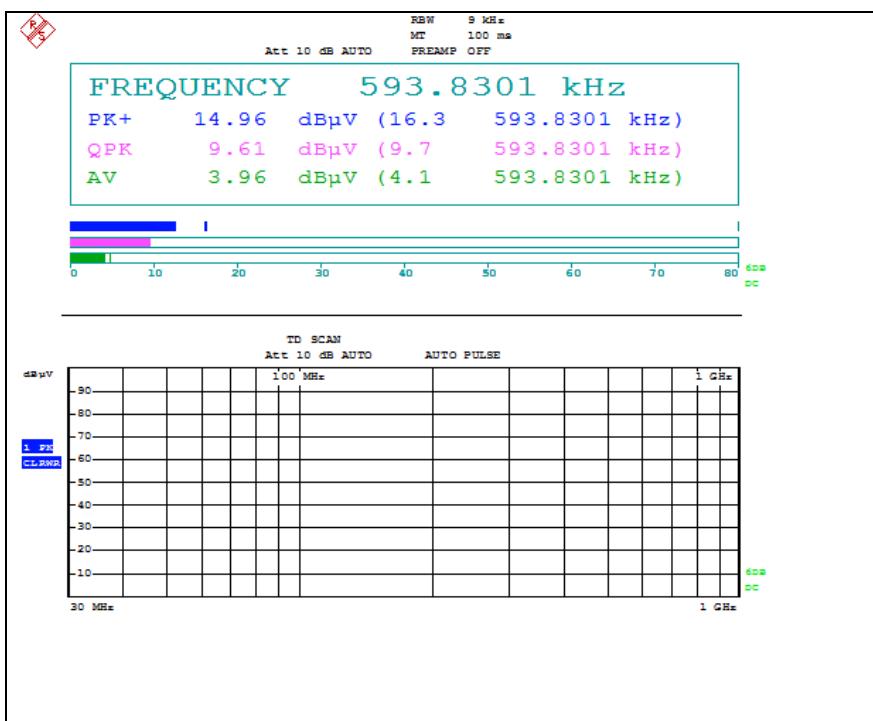
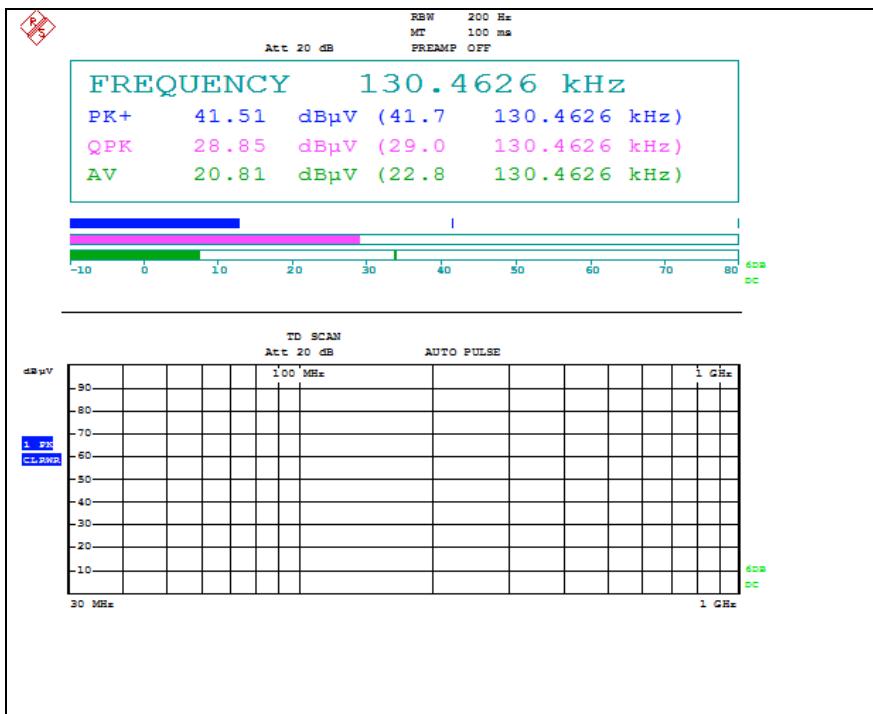
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)



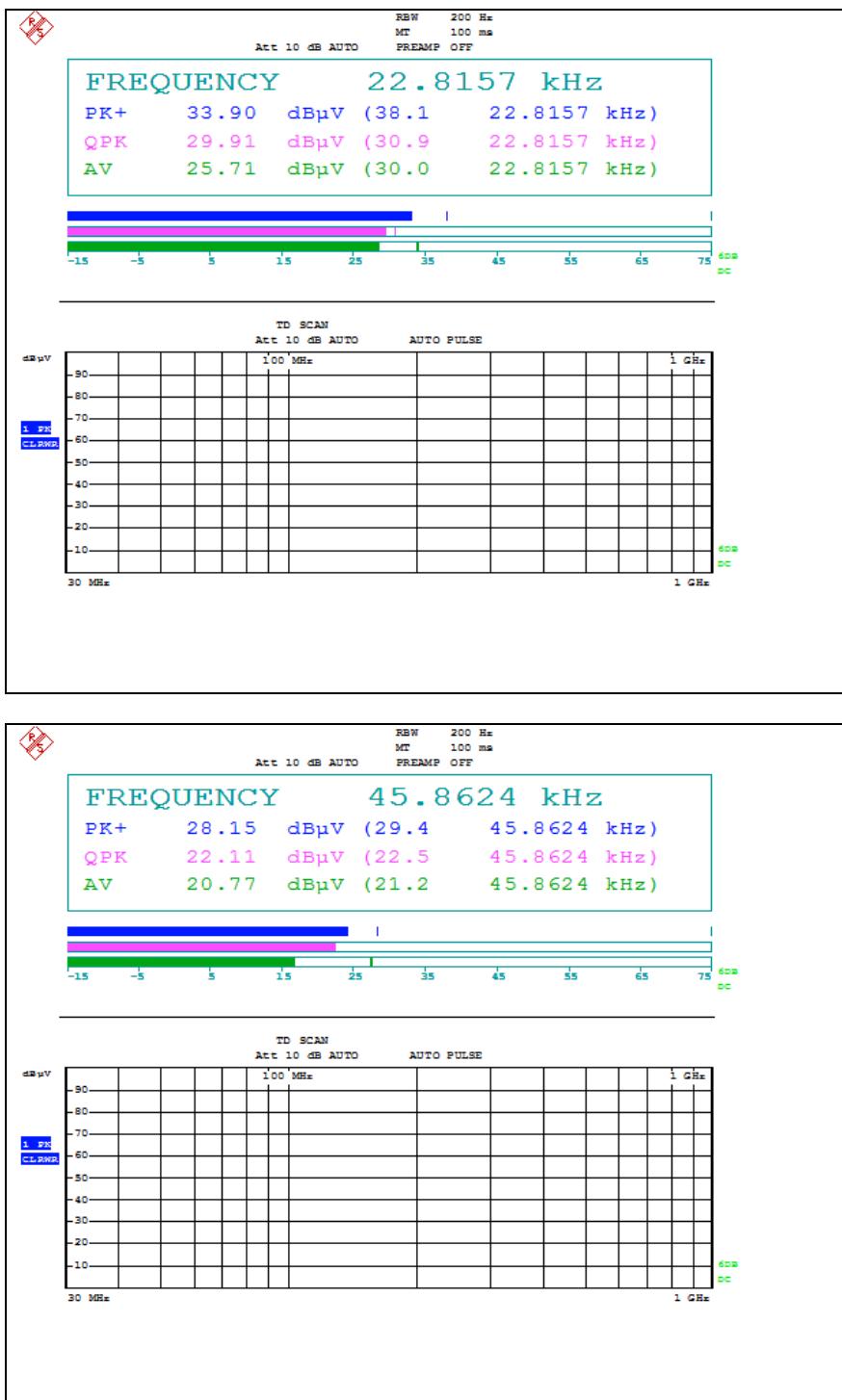
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TRU Antenna

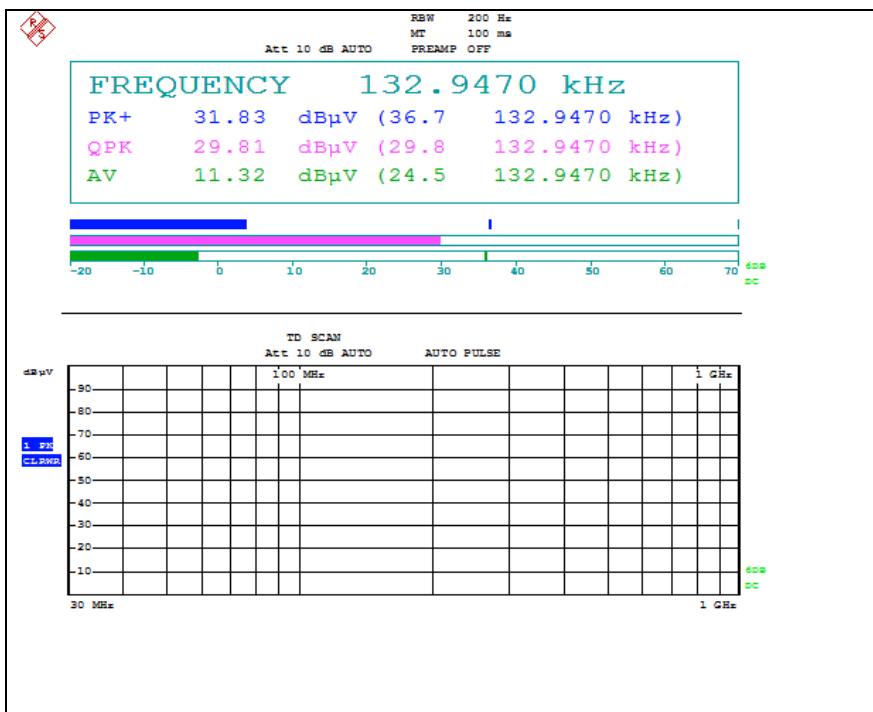
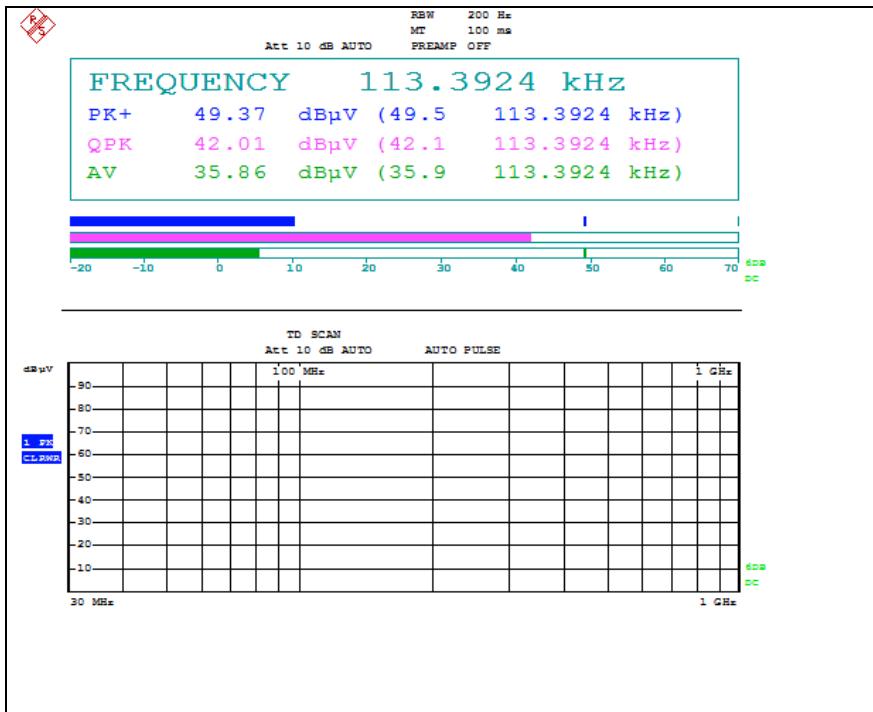
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RTT5041-20(2015.10.01)(3)

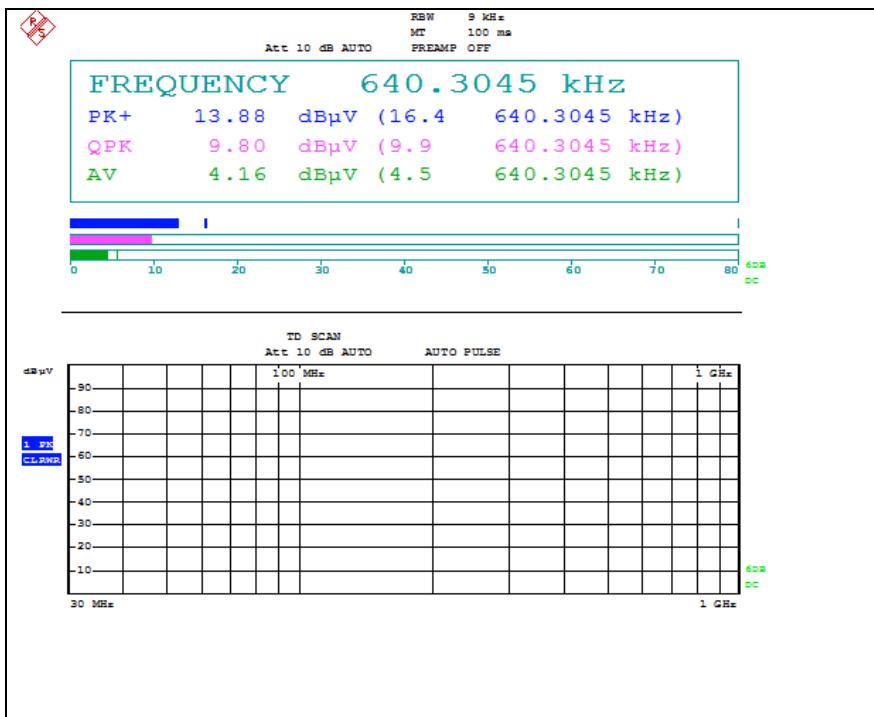
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

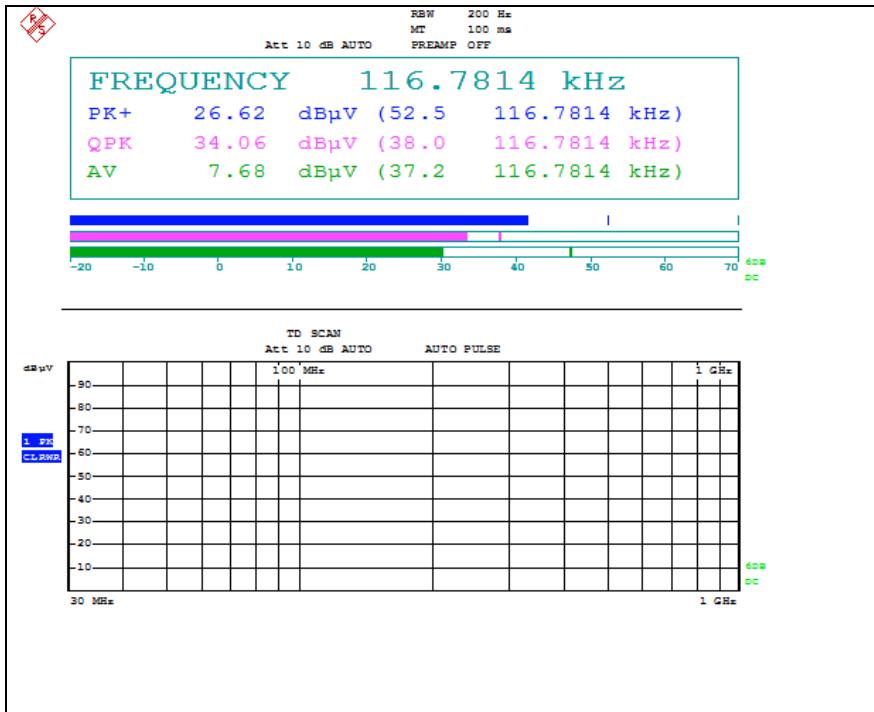


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SSB Antenna



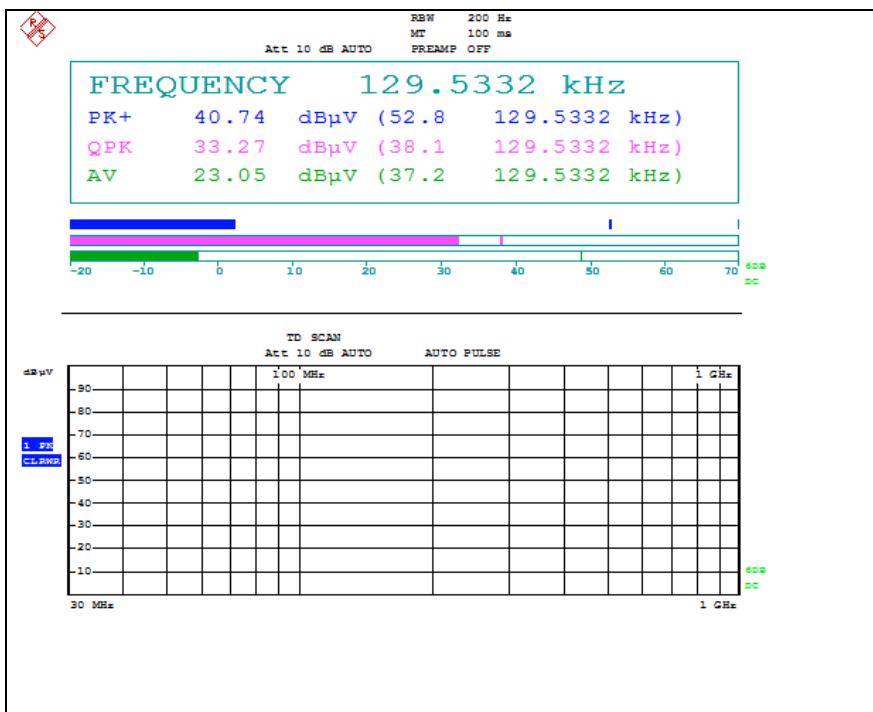
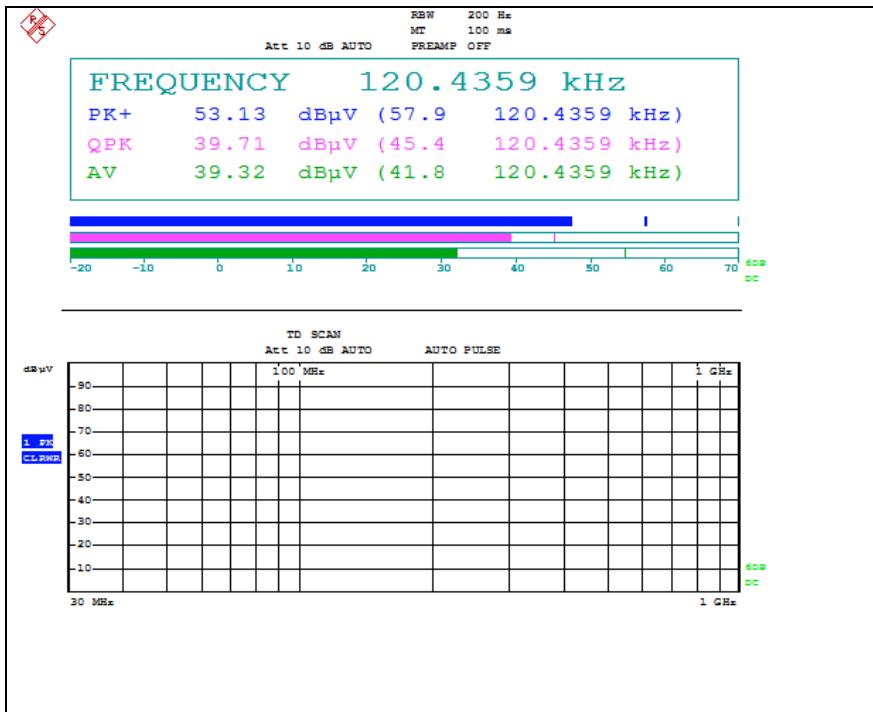
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A4(210 mm × 297 mm)



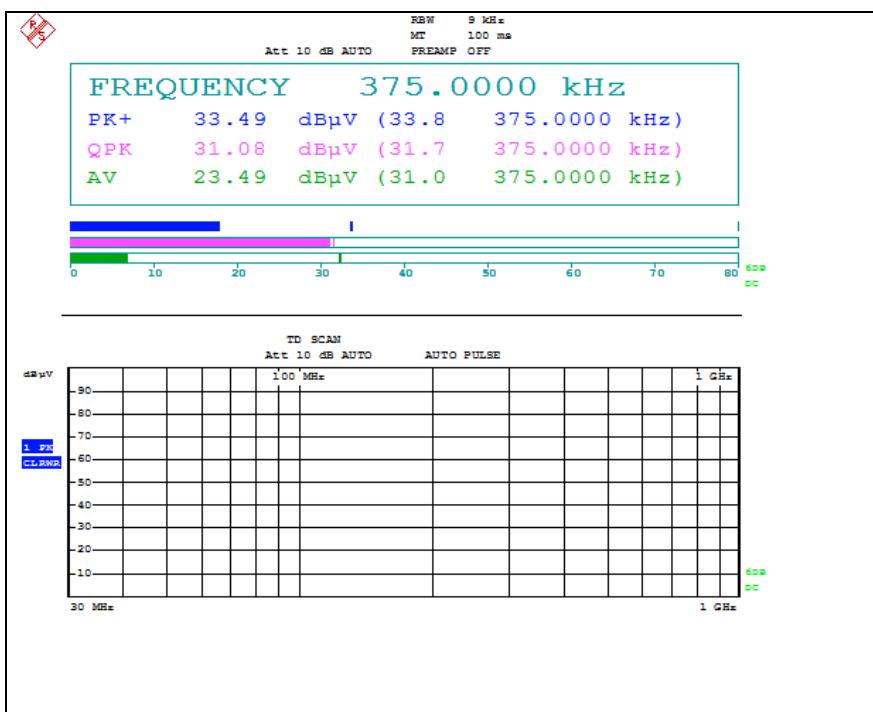
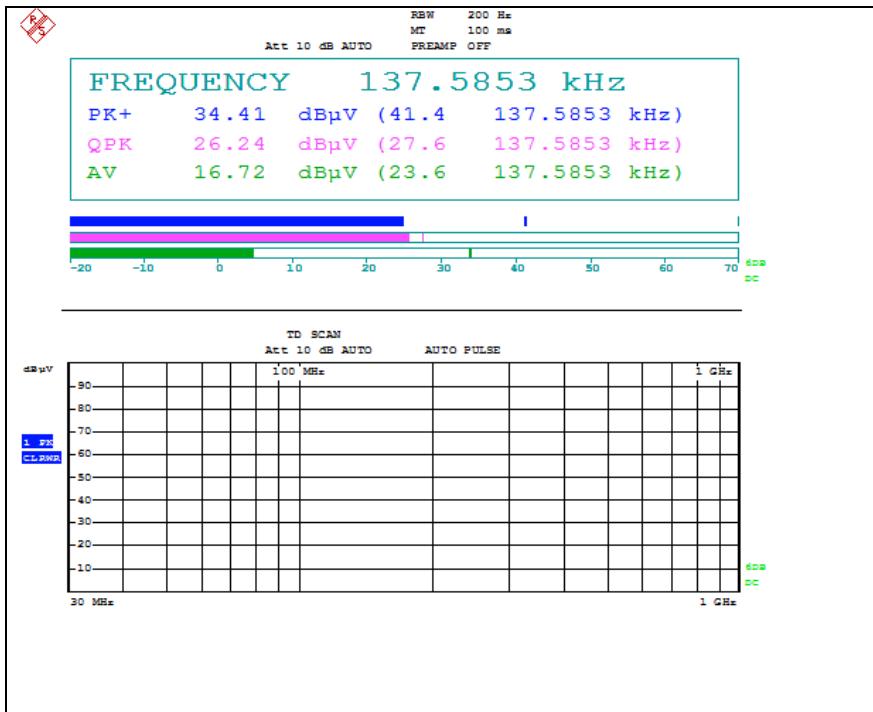
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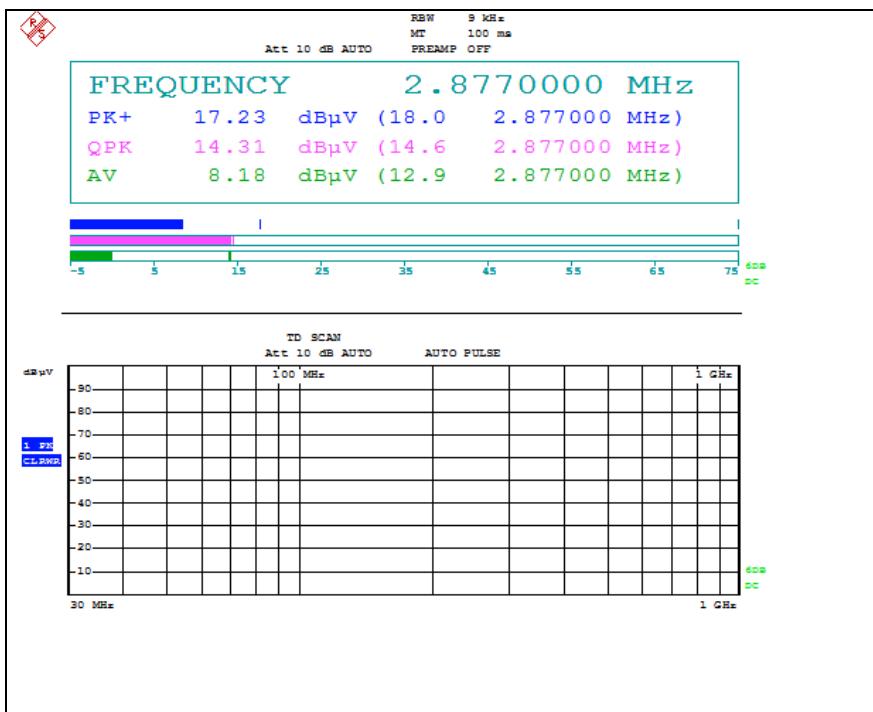
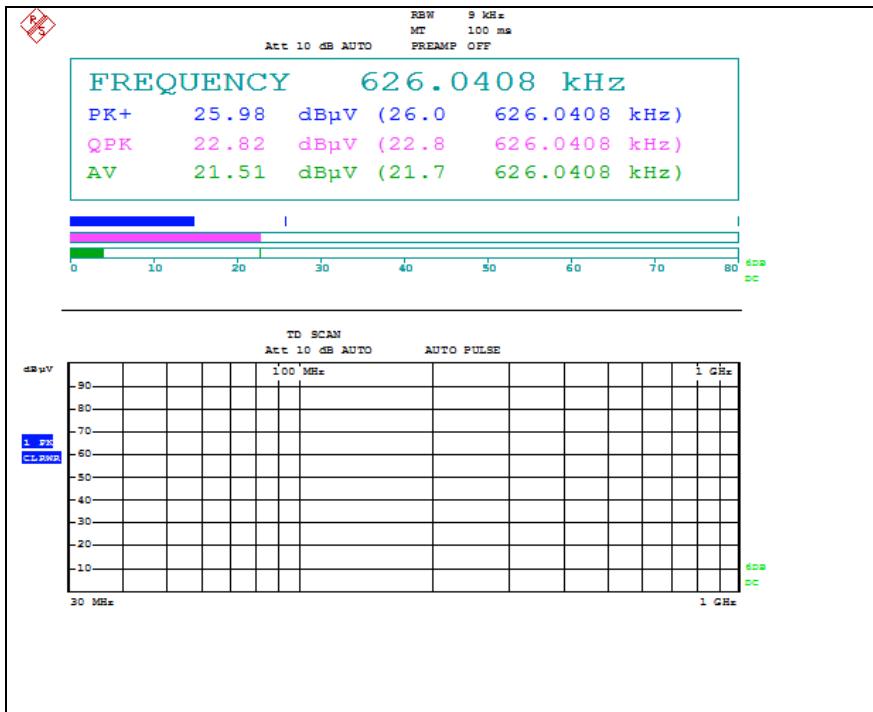
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)



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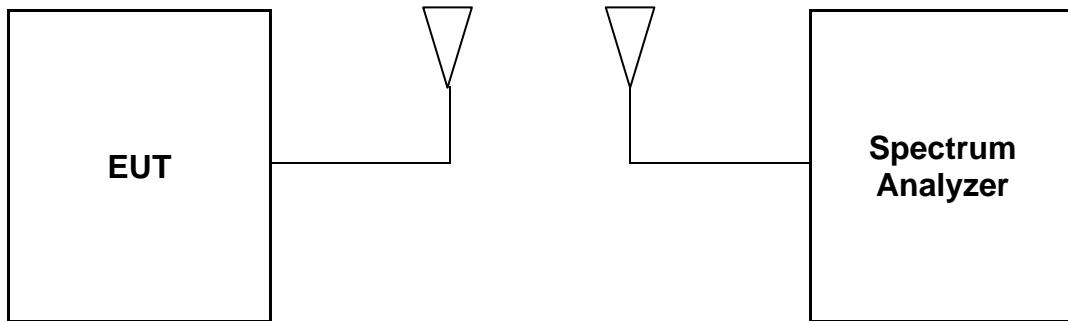
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Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

3. 20 dB Bandwidth

3.1. Test Setup



3.2. Limit

None; for reporting purposes only

3.3. Test Procedure

20 dB Bandwidth

- a. Span = approximately 2 to 3 times the 20 dB bandwidth, RBW = greater than 1 % of the 20 dB bandwidth, VBW = RBW, Sweep = auto, Detector = peak, Trace = max hold.
- b. The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.

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A4(210 mm x 297 mm)

3.4. Test Result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Test Antenna	20 dB Bandwidth (kHz)	Limit
DRV	9.021	Reporting proposed only
AST	9.081	
INT1	9.141	
INT2	9.231	
BUM	9.291	
TRU	9.201	
SSB	17.682	

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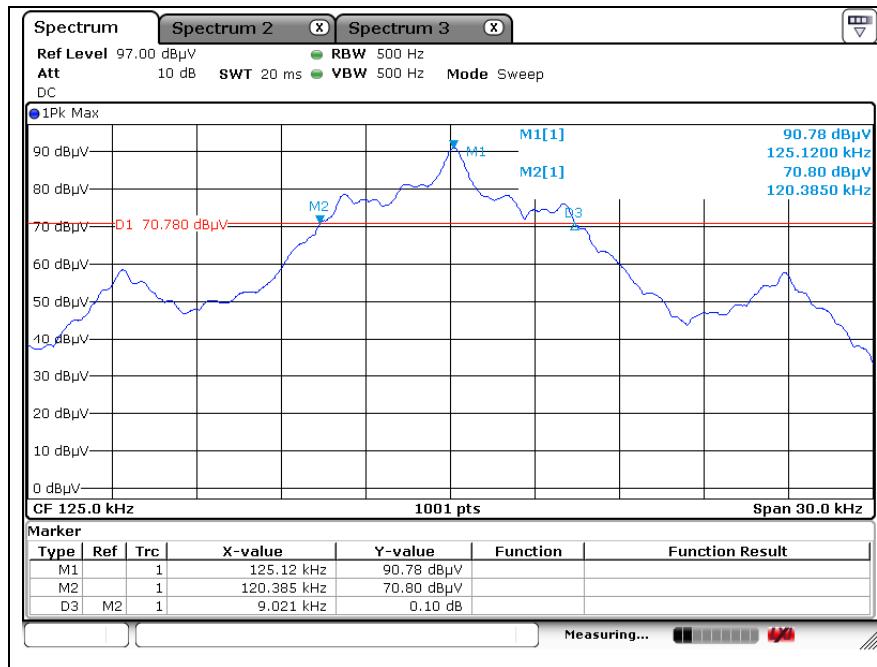
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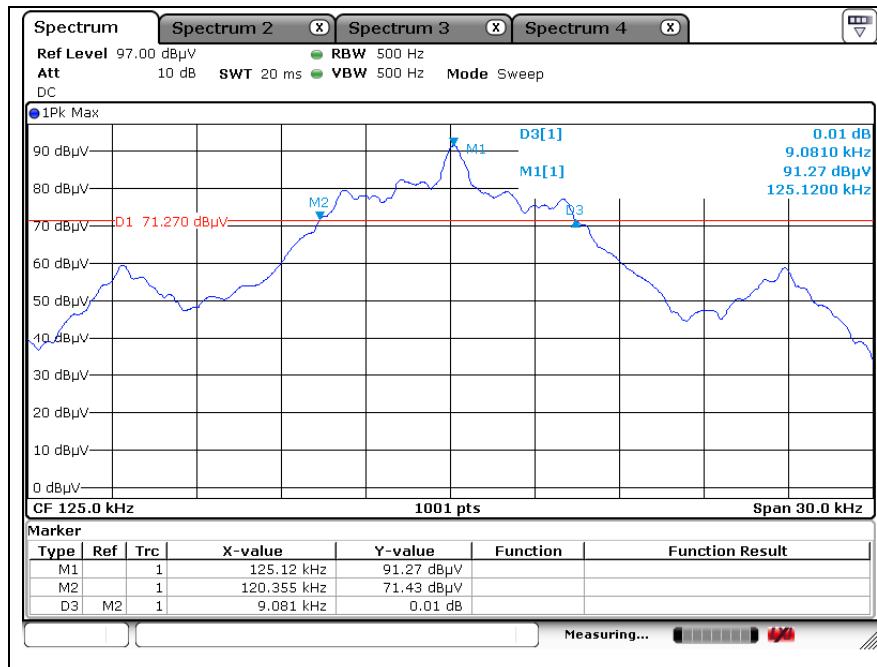
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

DRV Antenna



AST Antenna



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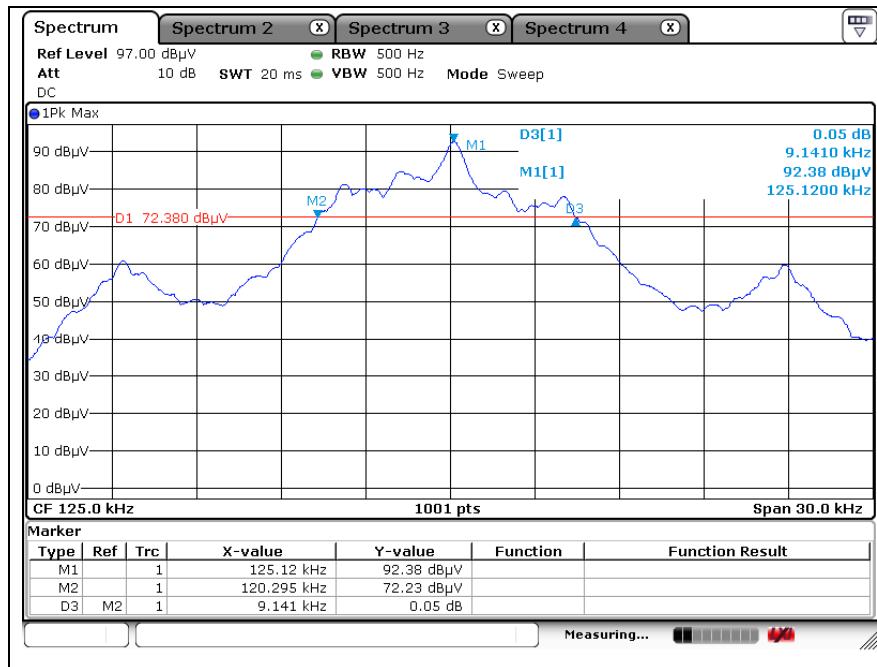
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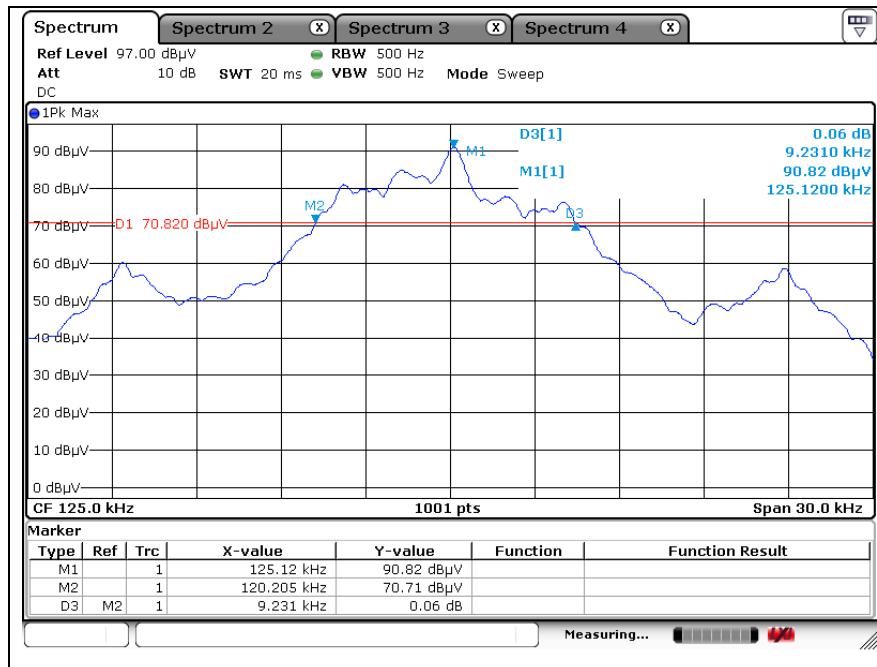
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

INT1 Antenna



INT2 Antenna



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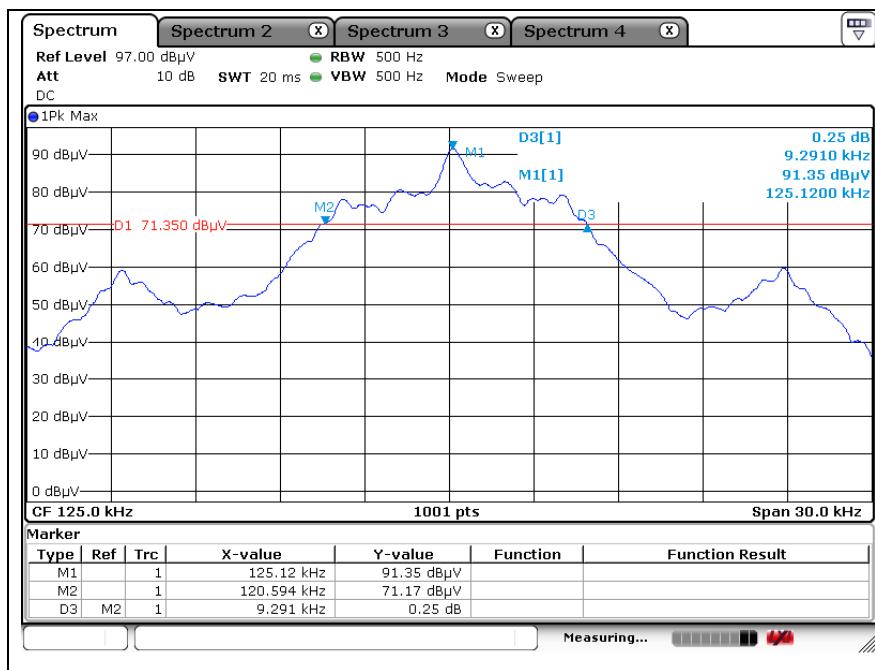
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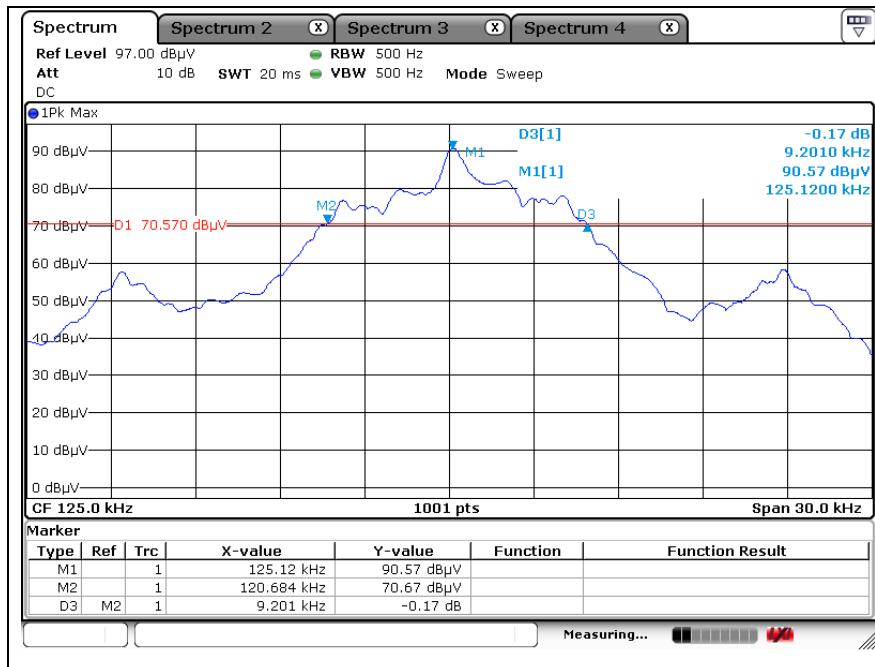
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

BUM Antenna



TRU Antenna



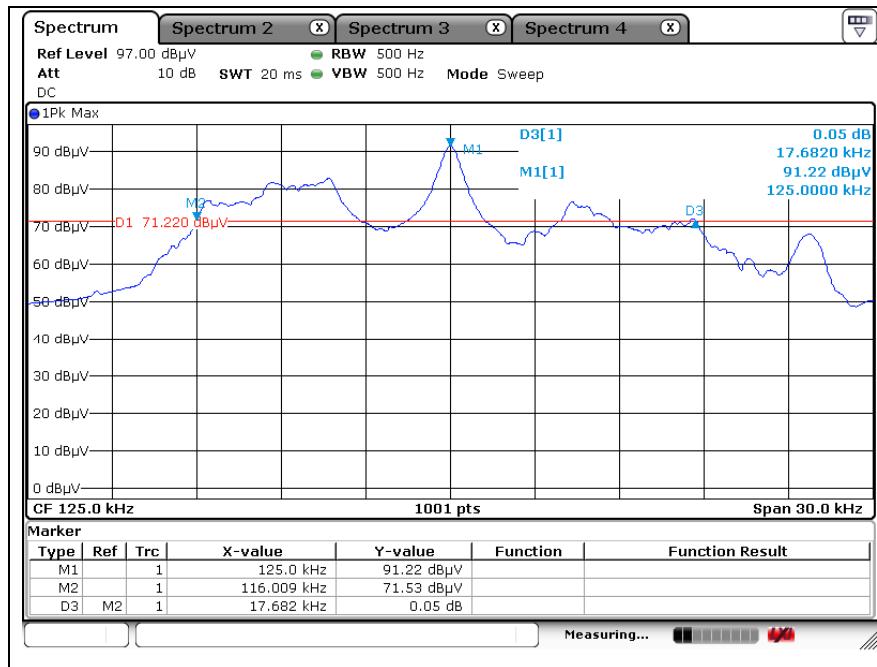
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A4(210 mm x 297 mm)

SSB Antenna**- End of the Test Report -**

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A4(210 mm x 297 mm)